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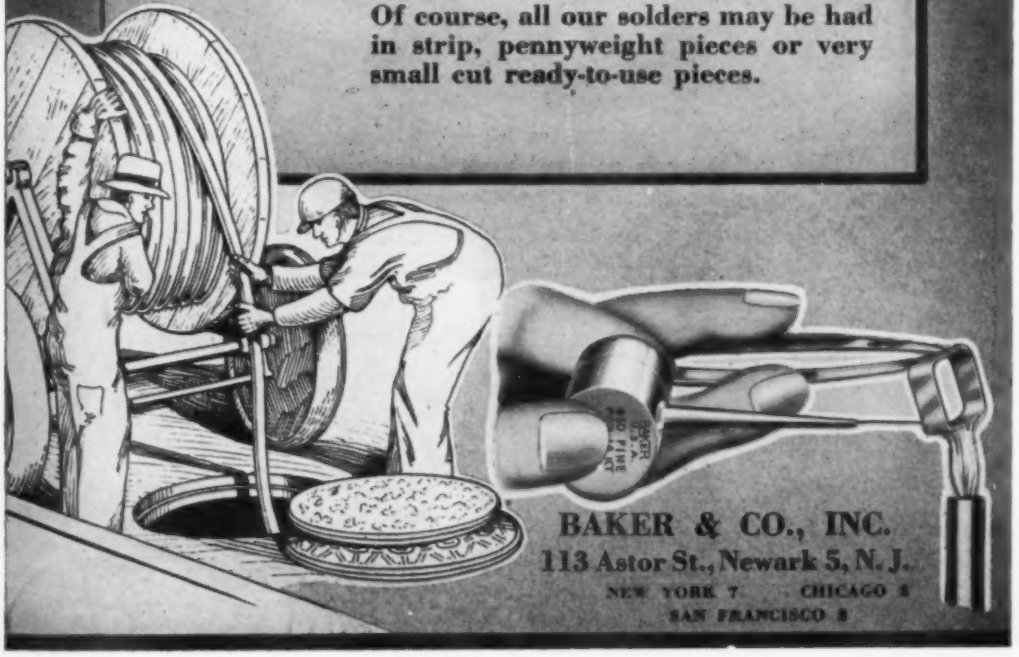

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Malpractice problems will always exist to some extent. It is apparent that very little relief can be expected from legislative action. Any real improvement, therefore, must come through the education of the profession and the public. This book has been aimed at presenting the subject briefly, yet with sufficient detail to enable the physician to inform himself of his legal obligation to his patient and to learn the ways in which he may safeguard himself against malpractice claims. The factor of prevention, which is so vitally important and which in respect to malpractice has been so much neglected by the medical profession, has received special emphasis.

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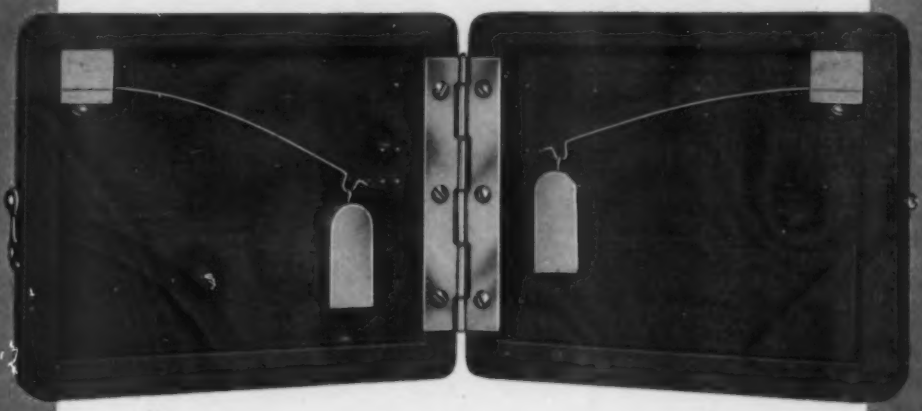

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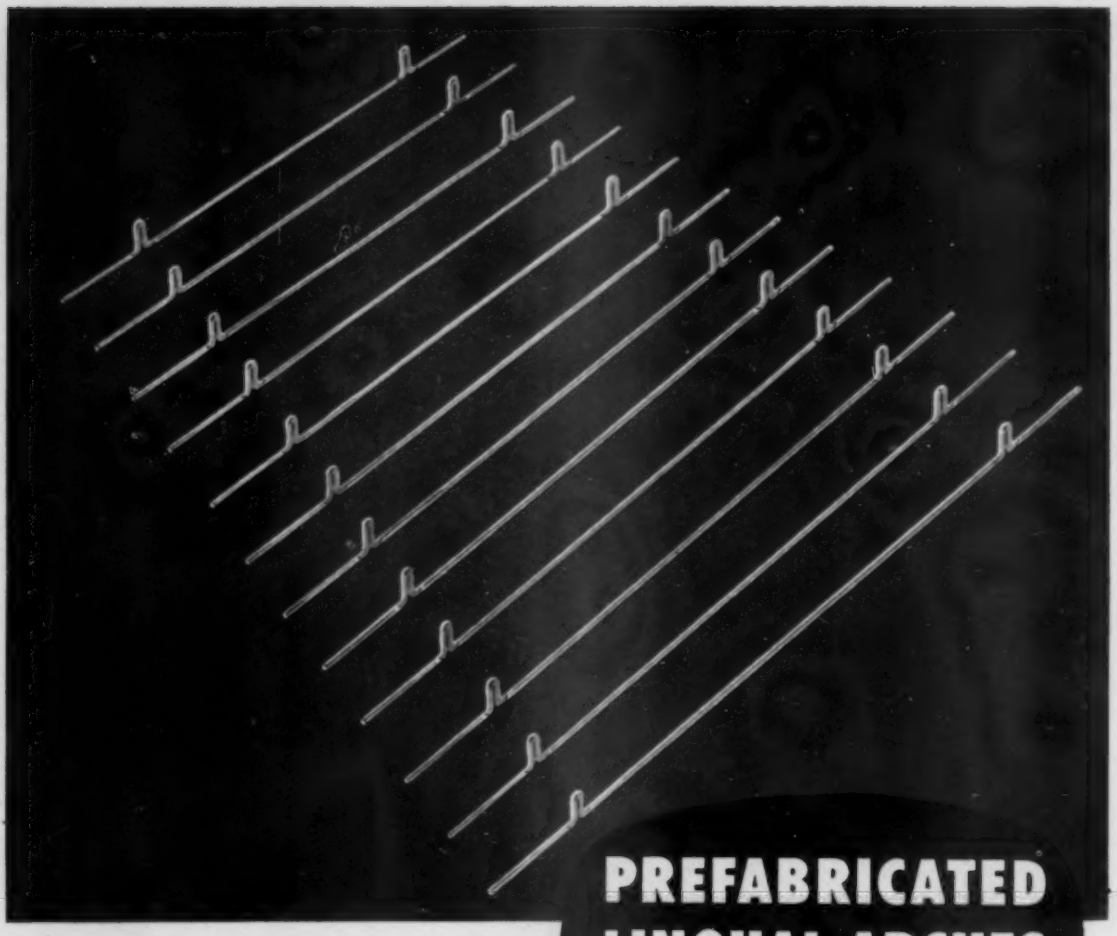

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VOL. 34 SEPTEMBER, 1948 No. 9

Original Articles

PRESIDENT'S ADDRESS

NORTHEASTERN SOCIETY OF ORTHODONTISTS

JOHN W. ROSS, D.D.S., PHILADELPHIA, PA.

IT HAS been decreed by long-established custom that upon retiring from office a president should make a final address and pass on to his successor recommendations, usually of things he should have done but did not do. In conformity with this custom, I wish to present some problems for your consideration.

The Northeastern Society of Orthodontists has had a remarkable growth. Many in this room remember when a small room at the Vanderbilt Hotel was large enough to hold all who attended. From this small beginning we have developed the largest membership of any component society of the American Association of Orthodontists. Our meetings have the largest attendance of any orthodontic meeting in the world. The value of our meetings is reflected by the number of articles published in the JOURNAL. Our presentations account for more pages than those required by the papers of the American Association of Orthodontists.

The preparation of these articles for publication requires a tremendous amount of work, and we have been negligent, as a society, in our appreciation of the work that Dr. Joseph D. Eby has done as our editor. I wish, especially, to compliment Dr. Eby on the January issue, the *Milo Hellman Memorial Number*. This is not only a fitting tribute to the late Dr. Hellman, but an expression of the careful work and diligence of Joe Eby who not only conceived but executed the idea.

The growth of our membership and the large attendance at our meetings have been due to the large number of men who have chosen our specialty as their lifework. I question whether we have fulfilled our obligation in our guidance of these men entering our specialty.

Presented at the Annual Meeting of the Northeastern Society of Orthodontists, Atlantic City, N. J., March 1 and 2, 1948.

Dentistry is selected as a lifework by a student. We need not discuss the reason. After four years in a dental school, he is graduated with a D.D.S. degree.

The undergraduate curriculum is based on the premise that a graduate will enter general practice. It is impossible in the time at the disposal in the undergraduate school to make him proficient in all departments of dentistry. Therefore, in orthodontics, emphasis should be placed on those principles and practices applicable to general practice. Treatment should be reserved for advanced training. This principle is recognized by the State Boards. Many states do not ask any questions on orthodontics, others ask one or two questions on orthodontics in connection with the prosthetic examination. Yet, legally, this inadequately trained man is permitted to practice orthodontics on the innocent public. In all the states included in this society he is also allowed to hold himself forth as a specialist even though he may have had no special training. If he has the financial resources and endurance, in due course of time he may become a member of this society and of the American Association of Orthodontists.

There is a difference between specialization and limitation of practice. We have allowed limitation of practice to serve as a basis of specialization rather than insisting that special knowledge and training qualify a man to render special services to the public.

In the territory covered by this society, we have thirteen dental schools graduating approximately half the dentists entering practice in the United States. Five of these schools give graduate instruction in orthodontics. Yet we, as the recognized society for our specialty, have done nothing toward setting up standards of graduate or undergraduate instruction.

With the enlargement of the graduate program to five schools in our territory, a more decided effort should be made to prevent courses of lower standards from being accepted on the same basis for graduate teaching as are those of university grade.

Some will bring up the inability of the present courses of university graduate grade to take all who wish to study our specialty, but the same situation exists to an even greater degree in our dental and medical schools. In one medical school in Philadelphia, only 165 men can be accepted from a list of 4,000 who are eligible. There are many similar instances. The same condition exists in dental schools, but these schools have not lowered their standards. Why should we have a low standard of qualification for our specialty?

If we are to maintain a high standard for our specialty, we must insist upon a high type of training for the man entering it. Adequate courses are being offered. For these reasons I make the following recommendations:

That a committee on education be formed in the Northeastern Society of Orthodontists.

That the duties of this committee be to meet with the heads of both the graduate and undergraduate courses in orthodontics in university schools in

our district and try to develop a correlation of teaching principles in orthodontics on both levels of education.

That this committee work in close harmony with the Committee on Education of the American Association of Orthodontists.

Following proper education we must have proper regulation by the states. Many states have an examination by the state examining board for men who wish to declare themselves specialists. No state included in this organization has such a law. If the public is to be protected, laws governing qualifications for specialization should be established.

A committee should be established in this society with a representative from each state covered by our organization. The duty of this committee should be the promotion of the passing of proper laws governing the legal basis of specialization.

Each state has a public health program adapted to the problems of the locality. The united effort of this society in each state should exert considerable force.

We should also concern ourselves with the problem of orthodontic care for the indigent. I recommend the formation of a public health committee for our society with a representative from each state represented in our society. The committee should study the problem and make uniform recommendations to each state legislature. I feel strongly that this society must begin to represent all sections over which it has jurisdiction. If it does not do so, we many soon have sections of the society breaking off and forming their own organizations. We must either measure up to the enlarged orthodontic problems as a society, or face the consequences; this is not a threat but a prophecy.

I wish to thank the Executive Committee and all those who have helped to make this program, only the second meeting away from New York City, possible. I am especially indebted to Dr. M. B. Markus and Dr. Donald Waugh, who are responsible for the fine program and the smooth running of the meeting. A society is no stronger than its secretary. I wish to thank Dr. Jacobson for his unfailing help. Mrs. Grimm deserves high praise for her part in making everything function efficiently.

I hope you have enjoyed the innovation of a meeting away from New York City. I feel it would be advantageous to follow this custom for one of our meetings each year.

May I thank you for the privilege of being allowed to serve as your president. It gave me a great deal of pleasure. I turn the affairs of the Society over to the new officers with full confidence that the affairs of the orthodontic world, as they relate to us, will receive wise consideration and capable handling.

1520 Spruce Street.

THE ROLE OF GROWTH ANALYSIS IN ORTHODONTIC INTERPRETATION

WILTON MARION KROGMAN, PH.B., M.A., PH.D.,* PHILADELPHIA, PA.

AN EGYPTIAN wise man once said, some five thousand or more years ago, "Be wary of speech when a learned man hearkeneth to thee, that thou mayest be established for good in the mouths of those that hear thee speaking." This admonition must be doubly advised when one speaks or writes from a theoretical foundation to a practical viewpoint or problem. I am interested in problems of orthodontics, yet I am not an orthodontist; I am concerned with the techniques and practices of orthodontics, yet I am neither technician nor practitioner. I bring certain more or less theoretical material to your attention, firm in the belief and knowledge that theory is the precedent to practice: the theories of yesterday are the procedures of today. So it is, therefore, that we must consider the broad sweep of the application of scientific knowledge in the field of growth and development, secure that such knowledge is of great practical import in the profession of orthodontics.

About ten years ago I wrote the following lines. They have not, in my opinion, changed much in substance, in fact, or in interpretation:

> Time has no constant value in growth and development: there are "spring-up" and "fill-out" periods; there are times of rapid growth, times of slow progress. But the major theme is one of integration, so that spring-up and fill-out, acceleration and deceleration, alternate harmoniously to produce balance, and at least an attempt toward the attainment of the optimum. It is worth remembering that perfection may be the standard, but adequacy is the goal.

Let me repeat: "Perfection may be the standard but adequacy is the goal." This does not mean that we are prepared to compromise; that we shall say, "Well, we can't quite achieve *all* of the effects that we wish." It means that realistically we are at grips with the fact that in dealing with individuals we are so seriously in contact with the problem of variation that reference to a norm, or so-called standards or averages, must be undertaken with great caution.

Let us consider what may be termed certain basic concepts in the field of human growth, as they apply to the area of concern to the orthodontist. These concepts have, we feel, a direct bearing upon the practice of orthodontics. Otherwise, it would be useless for us, as researchers, to be working in the field—we would be in a vacuum, as it were, with theory hollowly resounding against theory. The first concept is that of *change*. Let me bring to your attention some lines from the *Kasidah* of Hâji Abdû El-Yezdi (translated by Sir Richard

Read before the Northeastern Society of Orthodontists, Atlantic City, N. J., March 1, 1948.

*Professor of Physical Anthropology, Graduate School of Medicine, University of Pennsylvania.

Francis Burton):

Friends of my youth, a last adieu!
haply some day we meet again;
Yet ne'er the self-same men shall meet;
the years shall make us other men.

This sentiment may well be paraphrased to the effect that never does the orthodontist see the selfsame child during the course of treatment. With the progress of time each child is really a *series* of children, a series in a linked-up schedule of individual growth. Let it be repeated that change is a major phenomenon in the investigation of growth and development.

But there is a saving grace, even in this change: it occurs within a discernible pattern; it is in a predictable, measurable direction. Most important, the change is, in those cases demanding orthodontic therapy, under a potential dual control it *is* controlled by growth, and it *may* be controlled by orthodontic techniques. The dual control thus set up must be integrated, must be synchronized. One may well establish a basic law: "work with and through growth."

This brings us to our second concept, that of *progress*. It is really a corollary of the first. If we are dealing with change we are dealing with dynamics; if we are dealing with dynamics we are, in the very nature of the growth process, dealing with progressive changes in status: a dynamic march, a dynamic unfolding of the pattern of growth. If we accept this then we must accept, also, that when changes occur they do so in a relatively ordered fashion, in some mode of progress that can be analyzed, can be assessed. Change is not necessarily progress, but it occurs through progress.

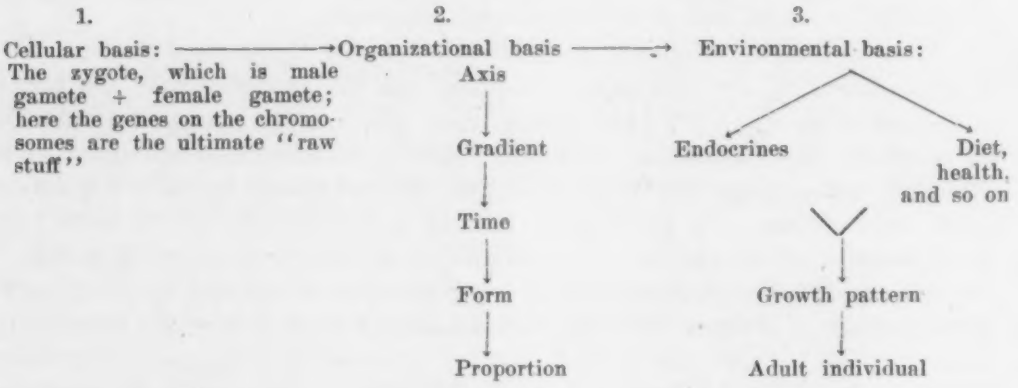
Without a break in our chain of thought we come to the third concept, that of *integration*, i.e., the harmonious interplay and intercorrelation of the forces and units of growth. We have thus a triad, which is the sum and substance, the summary, the epitome, of all that is going on within the growing, and thus changing, human organism: change → progress → integration. Thus it makes sense when we say of a given child, that he is not growing at the same rate at all times; that, indeed, it is quite logical to say that he is growing at different rates, in different functional areas or regions, and at different times. Thanks to the concept of integration, order and not chaos is most frequently the growth result.

Arising from the foregoing triad (admittedly a conceptual framework for the growth process), we come to a fourth concept. It is, for the first time, a really working concept, for it bears directly upon the growth area of import to the orthodontist. We refer to what may be termed *spatial accommodation*. This we must recognize because we are, in fact, working with a three-dimensional system in the cranio-facio-dental area: breadth, height, and depth or length. Moreover, we are, in the face, dealing with a bone-tooth relationship. We are, therefore, working with two major sets of variables: (1) complementary or compensatory growth gradients in three planes; (2) the developmental relation between two structural components, bone and teeth, that stand to one another in the dynamic roles of size, form, and supporting configuration.

What does the foregoing concept imply with reference to the practice of orthodontics? Let us be concrete. Suppose, for example, we look at the simple phrase, "moving a tooth." The phrase is *not* simple! The act of moving a tooth is part of a highly integrated chain of reaction: the tooth is moved with relation to adjacent teeth; the adjacent teeth are in an arch; the arch is in reciprocal relation to an opposing arch; the two arches are part of a faciodental complex; that complex is a part of—influences, and is influenced by—an entire growing organism; that organism is, of course, the individual child under treatment; but the child is the sum total of his biogenetic (family line) background, plus his environment (health, dietetic, socioeconomic, and so on). Move a tooth? Rather, say move or influence the pattern of coordinated growth. This sequence of reasoning, this cause-and-effect chain, is why we feel that growth theory may well be of service to orthodontic practice. It is our idea that a malocclusion may be a reflection of disturbed growth, either local, osteodental, or general—the entire organism.

In the preceding paragraphs we have more than once referred to the genetic or hereditary basis of the growth process. In the paper by R. M. Snodgrasse, which appears in this issue of the JOURNAL, there is outlined a single family line analysis. It has genetic implications in terms of generational transmissibility. Let us, therefore, consider the genetic background of this type of analytic approach. Chart I gives a rough outline of the *process of heredity.*

CHART I.



The process is not as simple and clear-cut as shown in Chart I, but the outline is a fairly good working basis. The first column is the child's phylogeny, as it were; it is his ancestral background; it determines the credits and debits that he will have in the bank of his life processes. With the second column we come to the child's ontogeny, though not in absolute terms; there is still a holdover of basic genetic influence. The axis and gradient of developmental growth are common endowments of all vertebrate life. There is a main longitudinal (cephalocaudal) axis, plus two at right angles to it and to each other (ventrodorsal and transverse). You see, we meet our old friends, "three planes of growth," as very firmly entrenched. The gradient of

growth is also very old; it refers to the rate along each axis which determines reciprocal and synchronized growth.

Let us pause for a moment and ask ourselves what this means to a human face. We may assume that, while axis and gradient are general vertebrate characteristics, they are also specifically human. Within the human face we can have dimensional and gradient growth of *only a very limited kind*—there is a hereditary limitation which is the result of a specifically human genetic complex. Therefore, we may accept the general conclusion that these two factors are so basic that they rarely, if ever, will come to consideration as etiological factors.

We come, then to the time factor. This really means time-linked, in the sense that gradients along an axis, or between axes, are integrated in their unfolding. There is a time when height, or length, or breadth, grows at its maximum; they do not all grow fast or slow at the same time. Thus, at birth the dimensional order in the face (on the basis of absolute and/or relative size) is width, height, depth. But the subsequent order of growth increment is height, depth, and width. There is a postnatal rearrangement of prenatal rates and dimensions.

This leads, logically, to form and proportion, which are simply the result of the interplay of the time-linked rates of growth in the several dimensions. The relatively broad, low, retruded face of the newborn progressively gives way to the relatively high, protruded, and narrowed face of the adult. It is in the time, form, proportion sequence, we think, that the most deviations or aberrancies take place.

If the last observation be true, then we may look to the third column for etiological factors. Here it is that the genetic potential is either achieved or modified. Certain it is that the endocrines are involved, though which endocrines, and precisely how, we are not sure. Certain it is, also, that diet and health are important. But, even here, we must invoke the time factor, for if an endocrine imbalance occurs, if malnutrition and ill health supervene, the effect in degree and in kind will vary with the time (and the time-linked gradient). This, by the way, is a good illustration of why growth must not be observed at the moment, but must be assessed over a period of time.

It is high time, now, to take stock of this pretty theoretical discussion. How far have we come? The answers may be stated: (1) there is a genetic basis for each individual dentofacial growth pattern; (2) the genetic basis tends to run in family lines; (3) the family line pattern must take cognizance of the contribution of genetic traits (or units?) from each parent; (4) the resulting combination may produce an actual intradental, interdental, or dentofacial disharmony; or (5) it may produce a harmonious complex; (6) in either case the inherited pattern may be modified by one or more environmental factors; and finally (7) remedial orthodontic therapy must take cognizance of the foregoing geneticoenvironmental complex.

We come now to the problem of implementing all of this; of learning the "laws" of hereditary growth, so to speak, so that growth theory may

become orthodontic practice. That is *our* goal; that is *your* need. First of all let us analyze how the physical anthropologist can be of aid. He is, by definition, a measurer; his is the yardstick of dimension, to give size and proportion. But in working with growth he must also work with and through time. We can, of course, give you status. We insist, however, in assessing progress. Your problems are not of the moment; you are not treating for

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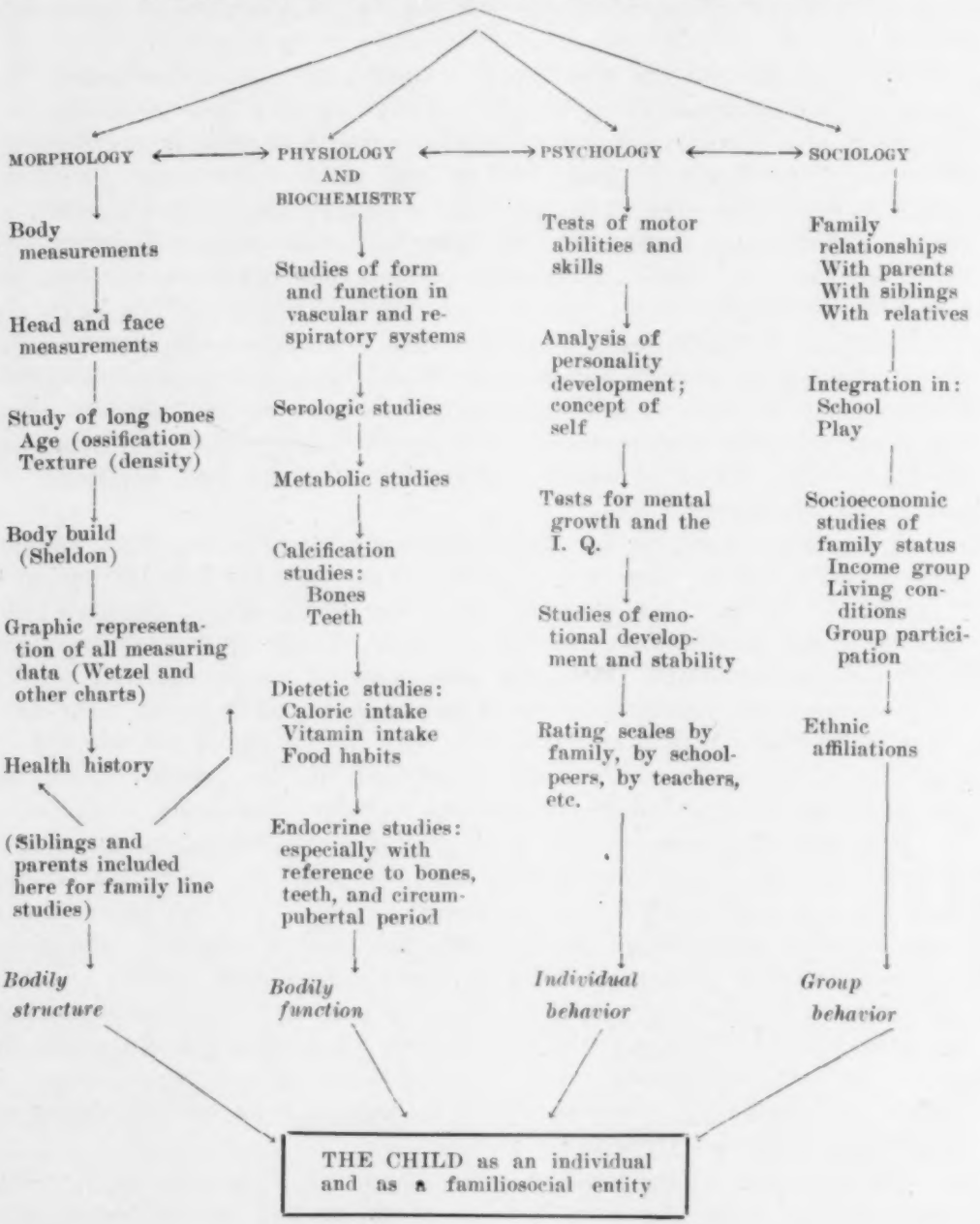


today alone—you are treating for all of tomorrow. We meet, therefore, on the common ground of growth problems: we are both concerned with *longitudinal growth*. Here, in outline form, is the aim of measurement:

1. Measurements and procedures to be taken.
   a. In three planes—height, breadth, and depth (the last either projected or radial dimensions from a focal point or axis).
   b. Demonstration of time-linking between rate and amount of growth in each plane.
   c. Elucidation, via measurement of head and face, and via analysis of x-rays of head and face, of norms of cranio-facio-dental development.
   d. Analysis of variability in the measurements in the three planes.

2. The purpose of measurements.
   a. To obtain standard patterns of faciodental adjustment.
   b. To analyze the interplay of growth in the three planes.
   c. To provide a basis not only for classification and diagnosis, but for the time-linking of treatment, and hence of prognosis.
   d. To provide the orthodontist with the knowledge whereby he will work *with* growth, not against it.

This is a large order, so large, indeed, that the physical anthropologist alone cannot fill it. Accordingly, we at the University of Pennsylvania are setting up a research unit to tackle the problem from many angles. It will involve cooperative effort: The Graduate School of Medicine and the Evans Institute of the School of Dentistry of the University of Pennsylvania; The Children's Hospital of Philadelphia; The Ellen H. Richards Institute of The State College of Pennsylvania. It will involve the cooperation of orthodontist, pediatrician, anthropometrist, physiologist, biochemist, endocrinologist, psychologist, sociologist, statistician, and many others. Our research program, in very broad outline, is presented in Chart II.

The philosophy of our concept of teamwork in research can best be given by lines from the Kasidah:

> All Faith is false, all Faith is true:
> Truth is the shattered mirror strown
> In myriad bits; while each believes
> his little bit the whole to own.

In a sense these lines may well be considered an epitome of some of the investigations in the field of growth that have gone on before: investigations from such a narrow, from such a circumscribed, viewpoint that each has believed "his little bit the whole to own."

It is our aim to take the "myriad bits" and to reassemble them into the "mirror of truth."

A FAMILY LINE STUDY IN CEPHALOFACIAL GROWTH

RICHARD M. SNODGRASSE, PH.B., M.A.,* PHILADELPHIA, PA.

MANY persons have raised the question whether or not malocclusion is inherited. We in the Department of Dentistry of the Graduate School of Medicine at the University of Pennsylvania feel that in the program of investigation described by Dr. W. M. Krogman in this issue of the JOURNAL (preceding paper), we have an unparalleled opportunity to tackle the problem along human lines—*along family lines*. In other words, we intend to approach the problem of malocclusion in a given child as a possible reflection of the transmission of heritable factors, subject to environmental conditioning, from both maternal and paternal sides.

In this paper I wish to present a first report† of such a family line study on head-face growth in a set of twins (Fig. 1), who are patients at the Orthodontic Clinic, their sister, three brothers, and parents (Fig. 2). This is not a definitive piece of research, but it is a step in the right direction. I shall indicate the techniques and methods used, the data collected, and shall offer some tentative conclusions.

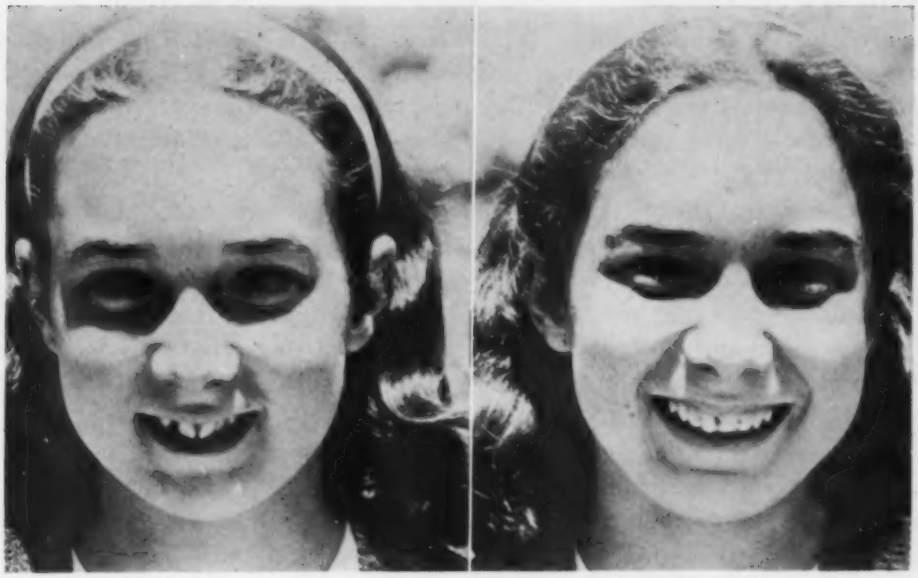
The following data are collected for such studies:

- Measurements of head, face, and body.
- Assessment of body type, according to Sheldon's technique of somatotyping.
- X-rays of head, face, and teeth.
- X-rays of hand to show skeletal development and maturation.
- Dental impressions and casts.
- Portrait and intraoral photos.
- Personal history items.
  - General health (with specific attention to diseases frequently or usually having serious aftereffects).
  - Menarche.
    - Periodicity and amount.
  - Pubescent signs in male.
  - Dental history.
    - Eruption time and sequence of deciduous and permanent teeth.
    - Occlusal history of child, siblings, and parents.
    - Dento-oral habits.
    - Nutritional history in general terms (obtained by questioning parents).
- National origin of patient, parents, and grandparents.
- Father's and/or mother's occupation (for estimate of socioeconomic level).

Read before the Northeastern Society of Orthodontists, Atlantic City, N. J., March, 1, 1948.

*Department of Dentistry, Graduate School of Medicine, University of Pennsylvania.

†In the investigation, the staff and graduate students in orthodontics, University of Pennsylvania, collaborated.



A. *B.*

Fig. 1.—*A*, Janet; *B*, Stefanie.

Fig. 2.—The X family. Left to right, back row: Mr. X; his sister, Miss X; Mrs. X; Frederick, the eldest son. Left to right, front row: Stefanie, Helen, Janet, and Henry. Seated: John, the youngest son.

Techniques and Methods.—The measurements which we routinely take on head and face are tabulated in Fig. 3, *A* and *B*. These are measurements which were used by Dr. Milo Hellman in the course of his research on dentofacial growth. He used them because he considered (1939) that they are "dimensions of those features of the face which, as held by orthodontists, are influenced by the effects of occlusion and consequently also by the effects of orthodontic treatment."

Following conventional anthropometric practice, we have taken, as did Dr. Hellman, height and weight in order to obtain some idea of general body size. In order to obtain a more detailed knowledge of body size and proportions, we have taken such measurements as reveal length of the limbs and of the component segments. We have measured, also, sitting height as well as the transverse trunk distances of shoulder, hip, and trochanteric breadth, and chest breadth and depth.

To assess the dentofacial growth of the individual child, i.e., to relate his dimensions at a given chronological age to his stage of dental development, we have used the standard deviation graphs, or "frames," as developed by Hellman. In these graphs, the limits of "normal" are placed at ± 1 S. D. Hellman devised a series of these graphs to correspond to the stages of dental development which he had formulated some years previously.

To compare the child's measurements as nearly as possible with those of his chronological age peers, the measurements taken by Gray and Ayres (1931) on private school children, chiefly within the Chicago metropolitan area, have been utilized by us in the construction of standard deviation graphs similar to those employed by Dr. Hellman. The Chicago children are, for the most part, of northwest European ancestry, i.e., Scotch, English, Irish, Scandinavian, French, Holland, and German. Other than height, weight, and a few head-face measurements, those chosen concern trunk size.

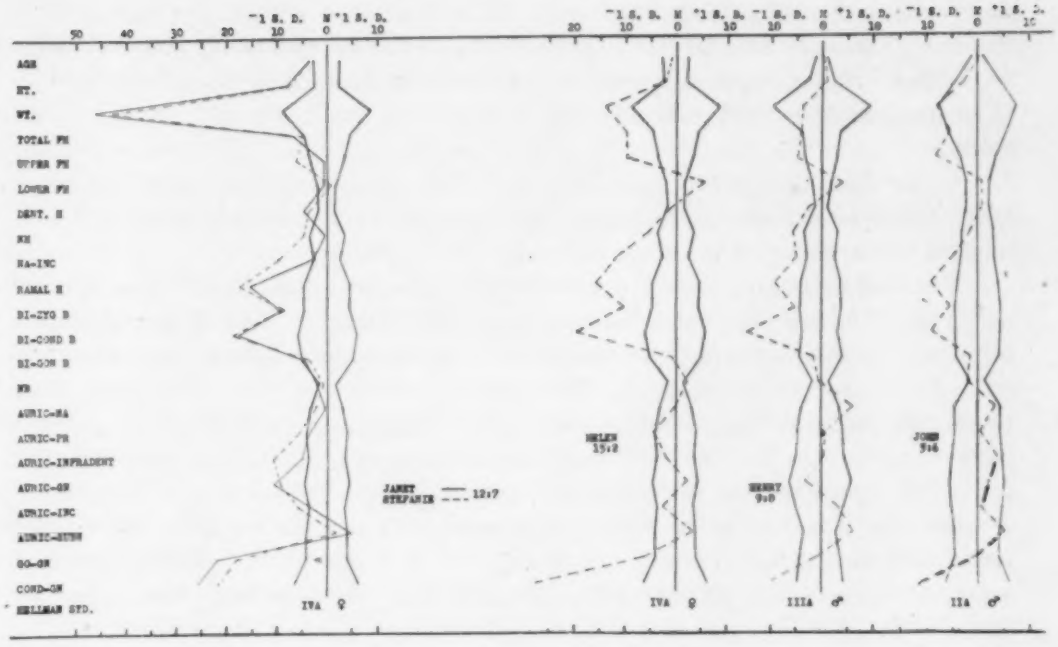
That we may consider the physique or body build and progress in growth as revealed by height and weight, these two periodically recorded measurements are plotted on the Wetzel (1941, 1948) grid. This grid is based on the measurements of several thousand Cleveland school children representing various socio-economic levels.

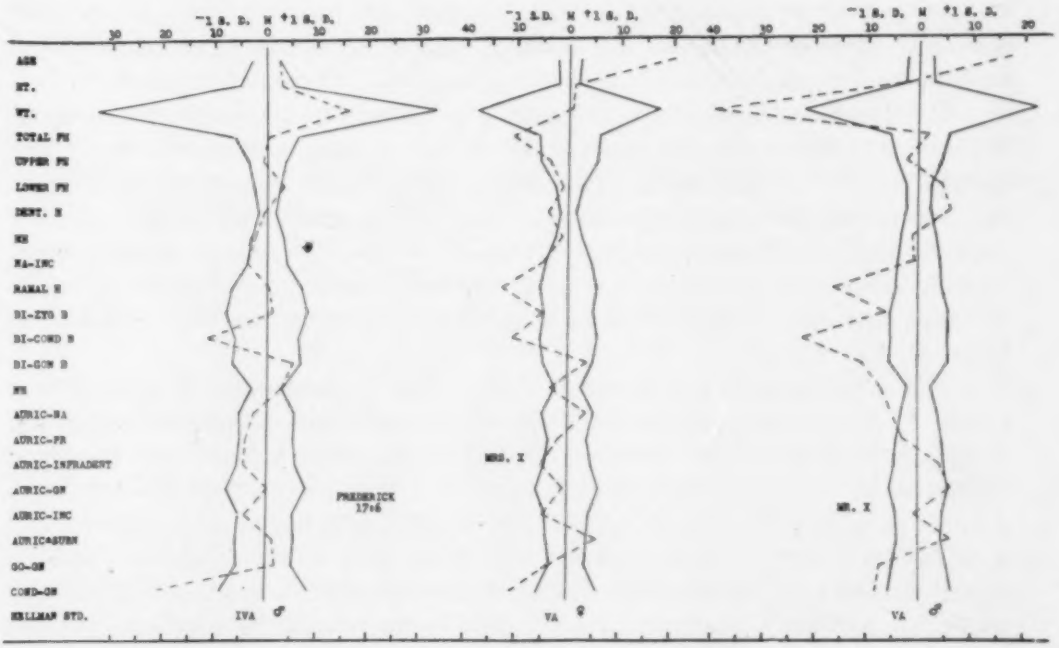
Skeletal status, Dr. T. Wingate Todd held, is the most efficient register of growth progress and maturational stage; therefore, x-rays of the patients' hands are compared with the White standards published by Todd (1937).

The assessment of body build by evaluating in each individual each of three components: endomorphy, mesomorphy, and ectomorphy (crudely: fat, muscle and bone, and linearity and fragility), on a thirteen-point scale* has been formulated by Dr. W. H. Sheldon (1940). Tentatively, because we do not yet have adequate standard for children, Sheldon's subjects being adults, we have somatotyped the patients of the Orthodontic Clinic according to the Sheldonian technique. In somatotyping directly rather than from standardized photos, we have, however, varied from Sheldon's procedure.

*Strictly speaking, the thirteen-point scale is an amplification, by half-steps, of the original seven-point scale and has not yet been described in print. The seven point scale is described in the 1940 publication.

A.





B.

Fig. 3.—*A*, Standard deviation graphs for assessment of dentofacial measurements with respect to dental stage; based on Hellman. Left to right, *Janet* and *Stefanie*, *Helen*, *Henry*, and *John*. Categories in column at left, from above downward: age, height (stature); weight; heights: total face, upper face, lower face, dental, nasal, nasion-incision, ramal; breadths: bizygomatic (maximum facial), bicondylar, bigonial, nasal; depths: auriculo-nasion, auriculo-prosthion; auriculo-infradentale, auriculo-gnathion, auriculo-incision, auriculo-subnasale; gonion-gnathion; condylo-gnathion; Hellman standard. Age of subject, in years and months.

B, Standard deviation graphs for assessment of dentofacial measurements with respect to dental stage; based on Hellman. Left to right, Frederick, Mrs. X., and Mr. X. Categories in column at left the same as those in *A*.

The Data.—Impressions of the twins' teeth were taken about the first of last November. When measured near the end of that month, the twins were 12 years, 7 months of age. They rank third in age order among their siblings. The eldest brother when measured was 17 and one-half years of age; the sister, 15 years, 2 months; the other two brothers, 9 and 5 and one-half years, respectively.

Other than the paternal great grandfather, who came from Germany circa 1840, the paternal and maternal forebears were chiefly of English and Welsh colonial stock, living in the eastern Pennsylvania-New Jersey region.

The father is an assistant professor of engineering in one of the colleges within the Philadelphia metropolitan area, and the family may be considered as belonging to the upper middle class. This socioeconomic rating has important implications for it indicates the potentiality, which the case apparently substantiates, for adequate medical and nutritional care. A pediatrician, a general physician, and a dentist have been in attendance. Visits are made to the dentist every six months and oftener if carious lesions appear.

General health may be described as good even though one twin had scarlet fever and at the age of 3 years had a mastoid operation. Both have had mumps, measles, and chicken pox. Tonsils and adenoids have been removed from both. Neither girl has achieved menarche.

The twins were breast fed through the first five months. No habits affecting dento-oral structures are reported. Appetite of both children is reported to be good now, but in earlier life both are said to have been light eaters. Diet and the variety of food willingly eaten by both is reported to be good.

The deciduous teeth of the twins are said to have had spaces between them. Their mother states that one could have inserted a penny between the maxillary central incisors of each child. A similar condition was observed in the permanent dentition when the twins came to the Clinic. Janet accidentally lost her upper central deciduous incisors at the age of 3. Her permanent upper central incisors erupted at about the age of 7. Stefanie began to lose her baby teeth at about that age. Both started to have fillings about the age of 4, and had to have several.

The twins have a Class II malocclusion (Angle classification) and a dental age of IVA (Hellman standards). Stefanie's maxillary premolars are buccal to those of the mandible, thereby "locking" the mandible when the teeth are in occlusion. Janet shows this condition to a slight extent on the left side. Janet's maxillary arch is somewhat more pointed anteriorly, i.e., tends toward a Gothic arch shape, while Stefanie's is fuller and more expanded. Janet's upper central incisors are rotated so that the mesial margin of each is directed somewhat forward. Stefanie's right upper central incisor is markedly rotated in this manner. Janet's right upper lateral incisor occupies a lingualward position, thus is "locked" back of the right lower lateral incisor when the jaws are closed.

Analysis.—Considering now (Fig. 3, *A*) the standard deviation graph for the dentofacial measurements of the twins, they are being compared with a sample of girls having a mean age of 16.00 years for which the standard devia-

tion is 2.59 years; hence, the twins at 12.6 years are somewhat below the "normal" age range for dental stage IVA. In general, it will be noted that their measurements,* too, are below the mean, and that several are considerably below the "normal" as defined by the standard. In the face, this is notably true of ramal height, bicondylar breadth, and various depths: auriculare-infradentale, auriculare-gnathion, gonion-gnathion, and condylo-gnathion. Their faces tend also to be short and narrow.

Attention may be directed to: (1) the over-all similarity in pattern shown by the graphs for the two girls; (2) the closeness with which several of their measurements approximate each other. This, of course, is what one would expect in presumably identical twins: extensive similarity in pattern and close approximation in numerous characters with occasional dimensions which are the same.

By virtue of being compared with girls who are 3.4 years older than they, it appears that the twins are being adversely likened. Further, since only height and weight were used by Hellman as indicators of body size generally, it is desirable that other measures be compared. For this purpose, the measurements published by Gray and Ayres have been used. The Chicago series has the additional advantage that comparison is made with children of approximately the same socioeconomic level as that of the twins.

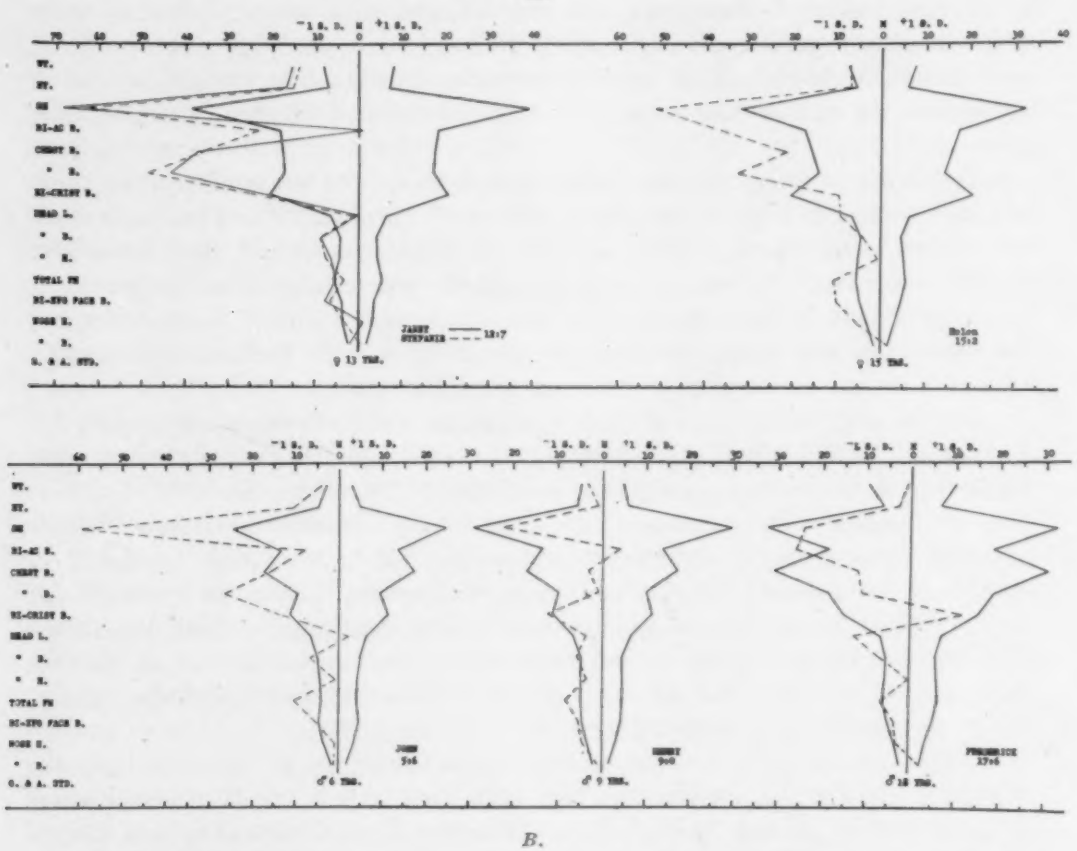
Again, Fig. 4, *A*, when plotted against the standard deviation graphs for 13-year-old girls (range, 12.5-13.5) of the Gray and Ayres series, a close similarity is apparent in the majority of the twins' measurements. Further, they are almost exclusively below the mean for the various dimensions of their approximate age peers. Additionally, they are below the stated "normal" in height, weight, sitting height, and chest dimensions. Bicristal breadths for both twins are at or just below "normal." The disparity in chest dimensions may be misleading because we have not taken these measurements in just the same way as did Gray and Ayres. Only in head length do the various cephalofacial measurements of both girls approximate the mean.

Upon plotting the respective heights and weights of the twins on the Wetzel grid (Fig. 5), we observed that both girls occupy the B_1 channel which is indicative of average build, i.e, a satisfactory type though inclining toward slender. Clinically, their physical status would be considered good. Plotting their developmental level rating, 94 for Janet and 98 for Stefanie, against their age gives an estimate of their development with respect to age. We thus find that Janet has reached the sixty-seventh percentile at 12 years, 7 months, whereas 67 per cent of children have reached that level of development by the age of circa 11 years. Stefanie has reached the 98th level at 12 years, 7 months, while 67 per cent of children reach that level by 11 years, 4 months. Thus we discover that Janet is about 1 year, 7 months retarded, while Stefanie is delayed about 1 year, 2 months. Had we previous height and weight records available for the twins, we could chart their growth previous to the present and give a

*Stefanie was measured by Dr. Krogman while I measured Janet. We work together as a team. The recorder directs the attention of the measurer to shifts in the child's position and to incorrect orientation of the instruments in order that possible causes of erroneous measurements may be eliminated.

more efficient analysis of their growth history. That which we obtain from only one set of readings is a static picture—a snapshot—of their position at one particular moment in time.

To evaluate their skeletal status, the hand x-rays of the twins were compared with the female White standards published by Todd. These indicate that Janet and Stefanie have a skeletal age of 12 years, 3 months, a rating which accords reasonably well with their chronological age.



A.

B.

Fig. 4.—*A*, Standard deviation graphs for assessment of various body and head-face measurements among chronological age peers; based on measurements by Gray and Ayres. Left, Janet and Stefanie; right, Helen. Categories in column at left, from above downward: weight, height (stature), sitting height, bi-acromial (shoulder) breadth, chest breadth, chest depth, bi-cristal (hip crest) breadth, head length, head breadth, head height, total face height, bizygomatic face breadth, nose height, nose breadth, Gray and Ayres standard. Age of subject, in years and months.

B, Standard deviation graphs for assessment of various body and head-face measurements among chronological age peers; based on measurements by Gray and Ayres. Left to right, John, Henry, and Frederick. Categories in column at left the same as those in *A*.

In somatotype, we rated Janet as 3-4-4[5] at the time we made the anthropometric measurements and observations. From this it is apparent that we judge the dominant component in her make-up to be linearity; however, she is not markedly linear. This is clear from the circumstance that she is slightly above medium in muscularity. The fat component, or endomorphy, forms the smallest part of her somatotype. Stefanie is of a closely similar build.

We have described the twins in some detail in order to indicate their close similarity, though rare identity, in numerous characters of head, face, and body. We have reported that both have a Class II malocclusion.

To what extent do the twins differ from or resemble other members of their family? To indicate some of these likenesses and differences, we have graphed (Fig. 3, *A* and *B*), the measurements of the others on the Hellman standard deviation chart appropriate to their respective dental ages.

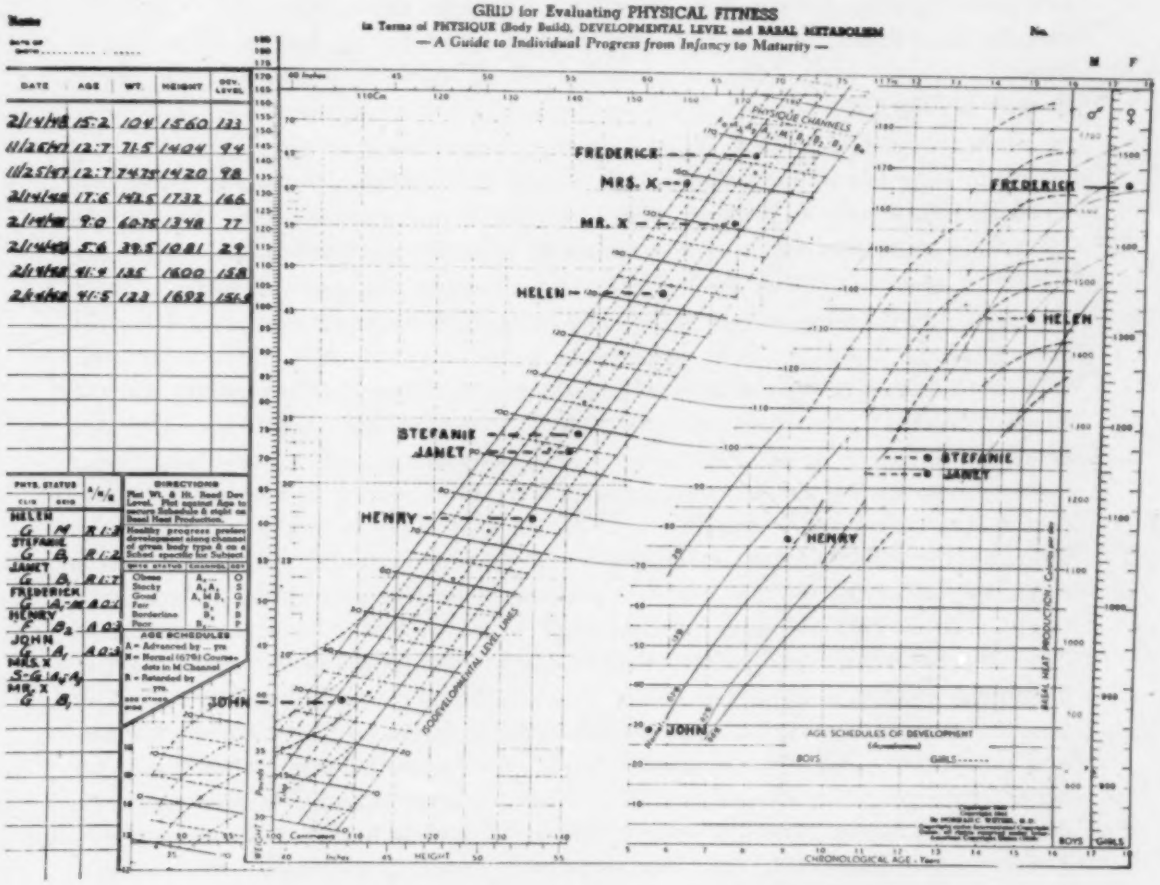


Fig. 5.—Body type, developmental level, clinical status, and development with respect to age as shown by plotting height and weight on a Wetzel grid. Data entered in upper left corner of grid appears in same order of family members as are named in the lower left corner under *physique status*. (Grid reproduced by permission of the publishers, NEA Service, Inc.)

Upon scanning these graphs, one's attention is caught by the pattern of deviation below the mean and/or "normal" in ramal height, bicondylar breadth, corpus length, and condylo-gnathion depth which characterizes most members of this family. Likewise, shortness or tendency to shortness of face is apparent in the various members of the family except the eldest son and the father; similarly, narrowness of bizygomatic breadth except that of the eldest son.

A similar patterning and positioning, chiefly below the mean and/or "normal," appears when the measurements of the siblings are graphed (Fig. 4, *A* and *B*) against those of their respective age mates among the children measured by Gray and Ayres.

Mrs. X remarked that when younger she resembled the twins in being small for her age, not showing a pronounced spurt in height until she was about 14 or 15. She did not achieve menarche until she was 17. Helen, at 15 years, 2 months, has not yet experienced menarche. Bayley (1946) observes that girls who are slow in reaching this stage continue to grow longer than do those who have catamenia early; hence, it may be that the twins will gain more in stature than might be predicted from their present height and skeletal age. Fred was short for his age until about two years ago when he started to increase rapidly in stature. All of the children are described as having been "light eaters" in their early years, a condition which appears to persist until about the age of 10 or 11.

In early infancy, Mrs. X had eczema, but it cleared about the age of 8 months. Like her mother, Helen had eczema in childhood, but it has persisted. Fred had this ailment from 4 months to about one year of age. Henry has an urticarial rash when eating some food, apparently strawberries.

The twins' dentition having been described on a preceding page, that of the family will be compared here. The mother, like the twins, has a Class II malocclusion. Like Stefanie, who shows a marked bilateral, buccalward position of the maxillary premolars, the mother's maxillary left premolars are noticeably buccal to those of the mandible. A similar but still less perceptible condition exists in Janet's dentition. Henry, next to the youngest son, has a cross-bite on the left side; however, his molars are in correct relationship. Intraoral x-rays show that the mother and Helen each have the upper right canine unerupted. Helen has the maxillary right deciduous canine retained. Fred's teeth, mesial to the molars, are in more nearly correct alignment than are the teeth of those other members of the family who have their permanent dentition. There is, however, some constriction of his arch. John has as nearly perfect deciduous dentition as one is likely to find, having nearly perfect spaces of accommodation. In having spaces between the incisors and between the incisors and the canines, John resembles the twins. The diastema separating the upper central incisors of the permanent dentition was present also in the deciduous set. John, as noted, has this trait in his deciduous dentition. The existence of a diastema is not known, the mother stated, among her family. In having a slightly larger and broader maxillary arch mesially than does Janet, Stefanie resembles her father whose arches are comparatively capacious. The father, the eldest son, and the eldest daughter have a Class I malocclusion.

The teeth of the father and mother exhibit some mutilations. Mrs. X states that her permanent teeth were always crowded and overlapped; therefore, the existing malocclusion cannot be attributed entirely to loss of teeth. Her brothers had to have their teeth straightened.

CONCLUSIONS

1. In this family a certain patterning in dentofacial and body measurements is apparent from the comparisons made with the standard deviation graphs based on the work of Hellman and of Gray and Ayres.

2. In general, there is a tendency toward submedium size. Interestingly enough, Mr. X states that he is taller than was his father; similarly, Fred is considerably taller than his father. This may be a reflection of improved medical and nutritional factors, or may in part reflect the recombination of ancestral traits.

3. A tendency toward late maturation* seemingly is more evident in the girls.

4. The resemblances which we see in this family are for the most part manifestations of heredity, not only in various external characteristics of size, build, coloring, and dentition, but in physiologic characters such as late menarche and allergies.

5. In the dentition, there seems to be a tendency for the hereditary traits from the maternal side to predominate over those from the paternal; however, they do not do so exclusively.

6. The over-all significance of such family records as are described here is that such information enables the orthodontist to anticipate some of the difficulty which he may encounter in the treatment of patients and to predict to some extent the likelihood and degree of success of the treatment which he applies.

7. This approach looks abroad to the fundamental causes of malocclusion as influenced by genetic and growth variables, and seeks to avoid some of the pitfalls of mere appliance therapy.

SUMMARY

1. A family line type of study is being used in the Department of Dentistry of the Graduate School of Medicine, University of Pennsylvania, in an investigation of the role of heredity in the production of malocclusion.

2. A set of girl twins, who are patients of the Orthodontic Clinic, together with their four siblings and parents are the subjects of this preliminary report on familial pattern in cephalofacial growth.

3. The types of data gathered and the techniques employed are: (a) direct measurements of head, face, and body; (b) x-rays of head, face, and teeth; (c) x-rays of hand for skeletal assessment; (d) estimate of body build; (e) dental impressions and casts; (f) portraits and intraoral photos; (g) questionnaire inventory of personal history re: (1) health; (2) pubescence; (3) dentition: eruption, occlusal history, dento-oral habits; (4) nutritional history; (h) national origin of patient and lineal ancestors; (i) parental occupation(s).

4. The methods of study used in the present report comprise: (a) plotting of subject's head-face measurements on a Hellman standard deviation graph for a sample of subjects of the same dental stage as that of the subject; (b) for an assessment of the subject's general body growth, plotting several body measurements and a few head-face measurements on a standard deviation graph, based on Gray and Ayres data, for a sample of age peers of the boy or girl; (c) for an estimate of body type, clinical status, and developmental

*A growth factor of which advantage may be taken in those cases where treatment has been unseasonably delayed.

progress as revealed by height and weight, plotting of these measurements on a Wetzel grid; (d) determination of skeletal age by comparison with the White standards formulated by Todd; (e) assessment of body build in terms of fat, bone, and muscle, and linearity and fragility according to the technique and method of Sheldon; (f) analysis of eruption and occlusal patterns and peculiarities; (g) comparison and consideration of familial history of growth, development, and physiologic idiosynerasies.

5. The conclusion is drawn that a consideration of heredity and growth variables will assist the orthodontist in the expeditious and successful treatment of patients.

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PRELIMINARY REPORT ON THE NEWER CONCEPTS IN THE MANAGEMENT OF BITE RAISING

JACOB STOLZENBERG, D.D.S., BROOKLYN, N. Y.

THIS paper is written with the intention of correlating the orthodontic philosophy of bite raising preliminary to the procedures employed in mouth rehabilitation in bite raising by dental prosthesis. I will also show some clinical changes that are accomplished in orthodontic procedures by initiating treatment with the palatal appliance (Fig. 2). Considerable work has been done in an endeavor to correct deep overbite conditions with prosthetic appliances, crowns, inlays, or splints. Some of the results have been disastrous.

Many general practitioners attempt to correct overbite conditions by using cast crowns, inlays, or removable occlusal splints for bite raising appliances. The application of this type of therapy is contraindicated according to biologic concepts of bone and root histology.

According to Spitz[1]: "It is biologically wrong to use crowns or inlays to heighten teeth which have been hindered in their proper eruption by a deep bite, or some other cause. Such submerged teeth must first be given the opportunity to erupt by means of orthondontic treatment."

It is not my intention in this paper to enter into the finer details of orthodontics, or to study the intensive physiologic tissue changes that occur. It is my purpose to present:

A. Clinical evidence of changes that occur during repositioning of the mandible.

B. The relationship of growth of the dental arches to function in the oral cavity.

C. The musculature involved in the mandibular function. Particularly, it is my intention to demonstrate the growth changes that are manifested, and the rationale for use of the removable bite plate.

The palatal plate used has an inclined plane, similar to the Hawley bite plate, rather than a flat plane. The incline influences the repositioning of the mandible anteriorly and re-educates the musculature during function. With the flat plane there is a tendency to function posteriorly and consequently defeat our objectives.

The removable plate was used by Dr. Kingsley* in 1880, and was then known as a bite jumping appliance. There is no doubt that satisfactory results were obtainable then, as they are now. However, contemporary concepts and recent clinical and histologic findings demonstrate and justify the use of this appliance in present-day therapy.

Read before the Annual Meeting of the Northeastern Society of Orthodontists, Atlantic City, N. J., March 2, 1948.

*Oral Deformities, 1880, p. 84.

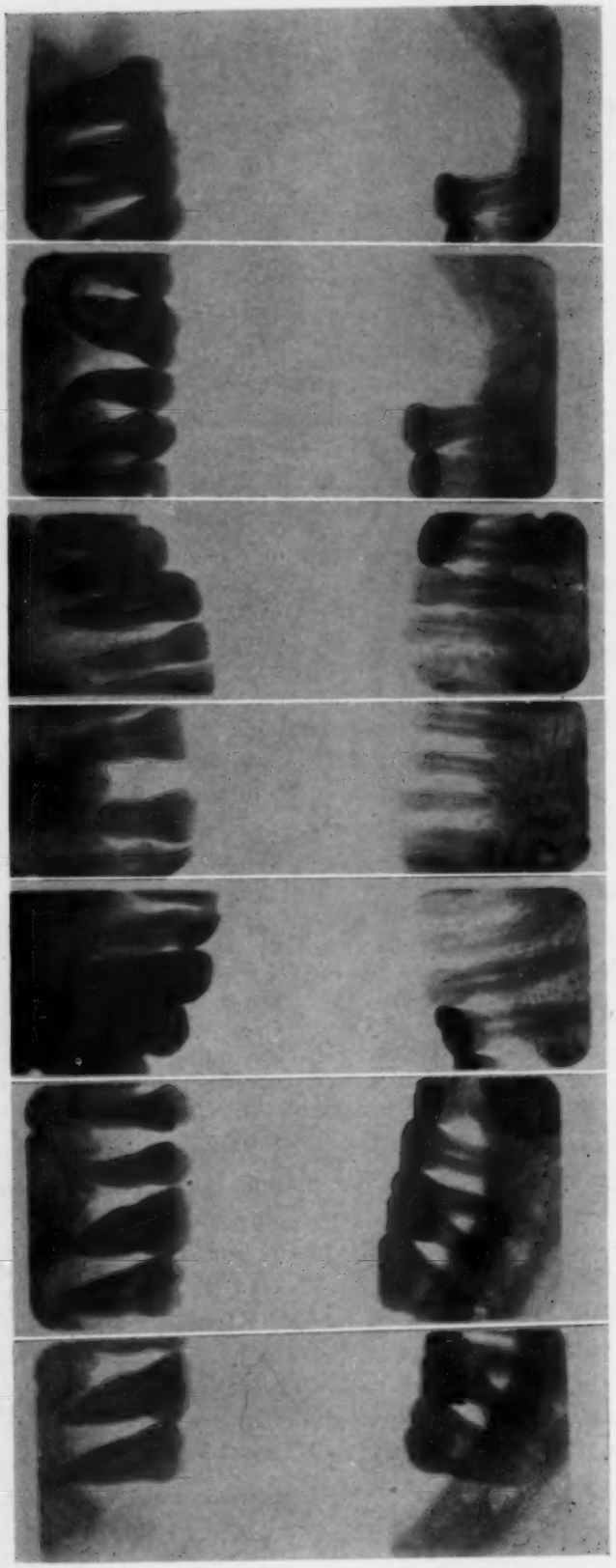

Fig. 1.—Female, aged 38, who wore prosthetic splints. X-rays showing destruction of tissue.

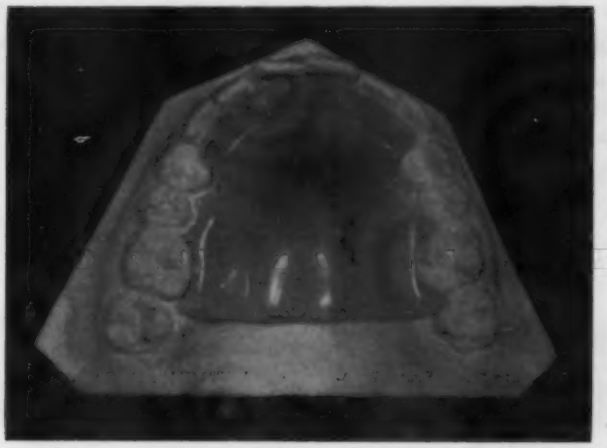

Fig. 2.—Palatal bite plate.

Fig. 3.

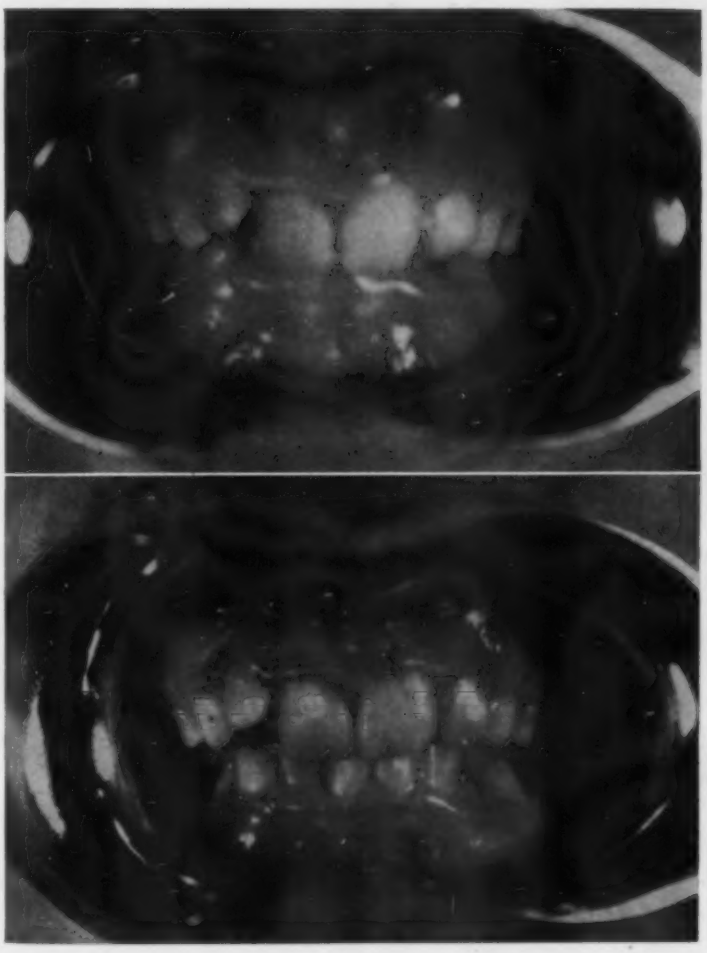

Fig. 4.

Fig. 3.—Patient, aged 7, without palatal bite plate.
Fig. 4.—Patient with palatal bite plate.

The palatal plate aids in altering the functional relationship of the mandible to the maxilla by retraining the muscular synergisms and antagonisms which directly influence the position of the mandible during function. There is a depression of the mandibular anterior teeth, when brought into functional contact with the palatal incline.

This makes occlusal contact of the posterior teeth impossible, thus encouraging an elongation or eruption of the posterior teeth until they meet in functional occlusion.

Fig. 5.

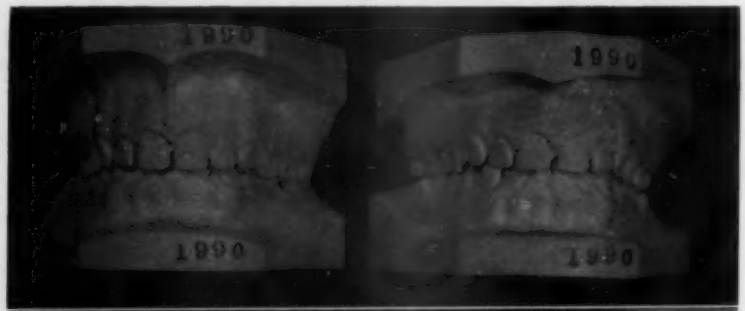

Fig. 6.

Fig. 5.—Patient, aged 16. Left, without palatal bite plate; right, with palatal bite plate.
Fig. 6.—Intraoral after treatment.

According to Gottlieb and Orban[2]: "The progressive eruption of the tooth in the oral cavity as the epithelium becomes detached is known as continuous passive eruption. On the other hand there is an actual upthrust of the tooth against the plane of occlusion, and is known as the continuous active eruption of a tooth. In the absence of an antagonist, a tooth has a faster active eruption."

On children and adolescent patients, the palatal appliance may be initially instituted to reorient the mandible in an altered functional position, and to train the muscles for muscular automatism and balance. According to *Stedman's Medical Dictionary*,[3] automatism is a state of independence of the will or of central innervation. It is a condition in which movements are made without conscious exercise of the will.

Muscular automatism is coordinated muscle reflex, which is a conditioned reflex and does not have to stimulate the brain center for its impulse. This is demonstrated in habitual function during mastication. The mandible traverses a definite path, which is habitual and automatic. Muscle will either atrophy or hypertrophy according to function, and therefore can readily accommodate itself to adjusted conditions. Coordinated muscle function must harmonize in balance where the mandible is involved. This is indicated in proper speech, mastication, and respiration.

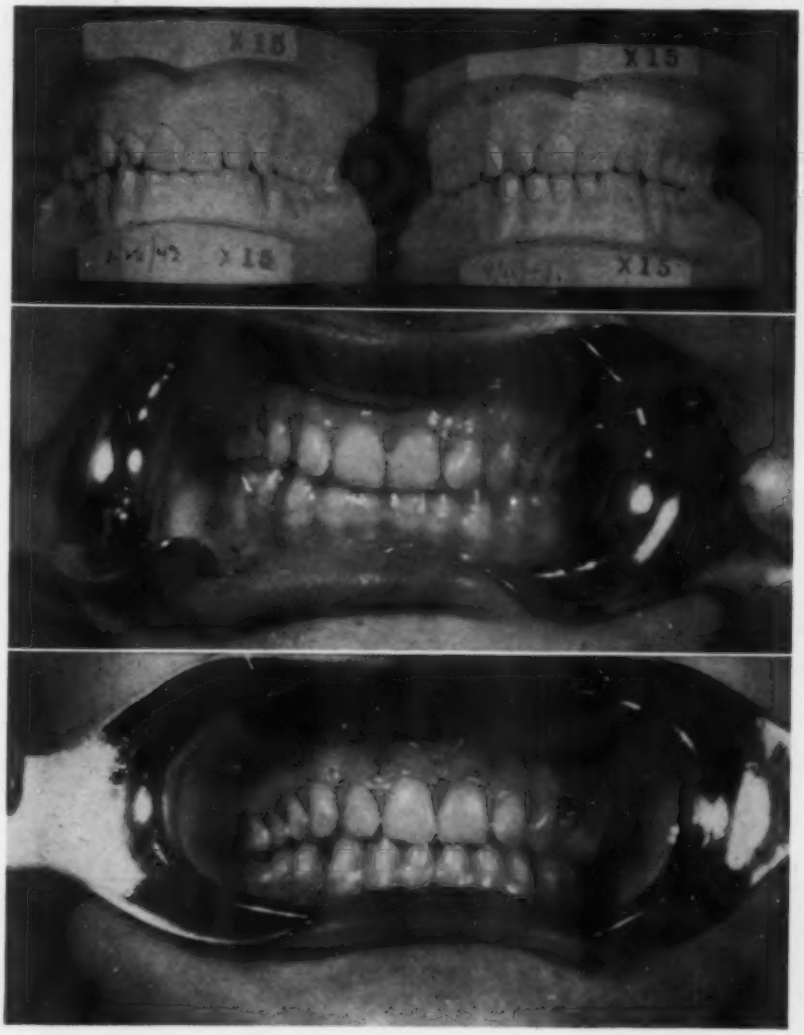

Fig. 7.

Fig. 8.

Fig. 9.

Fig. 7.—Patient, aged 19, models before and after treatment.
Fig. 8.—Intraoral before treatment.
Fig. 9.—Intraoral after treatment.

According to Breitner[4]: "Experiments done with the rhesus monkey with histological study indicated that there were changes in the alveolar bone surrounding the posterior teeth, the angle of the jaw, and the temporomandibular joint. Also that forces applied resulted in a mesial movement of the

posterior teeth, and indicated a reorientation of the position of the body of the mandible, and changes in form and position of the condyle head and glenoid fossa. . . . There is a depression of the mandibular incisor teeth, and an elongation of the molar teeth.''

Fig. 10.

Fig. 11.

Fig. 12.

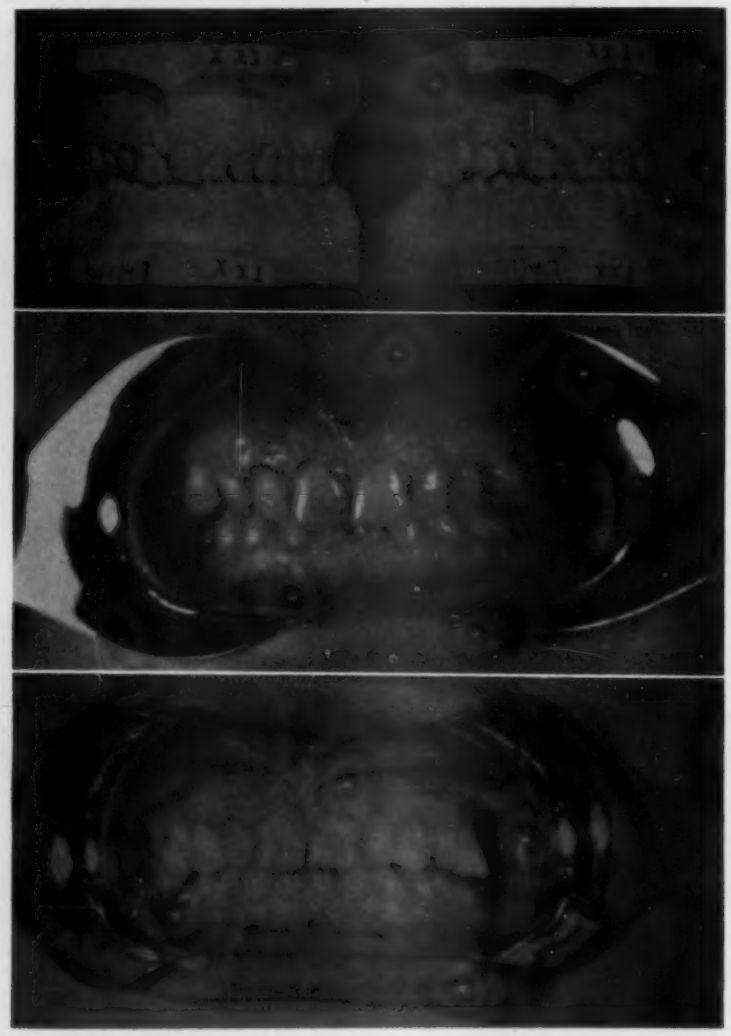

Fig. 10.—Female, aged 35, before and after five months' treatment.
Fig. 11.—Intraoral before treatment.
Fig. 12.—Intraoral after treatment.

The mandibular bone enjoys an articular relation with the base of the skull that permits it to leave its socket during normal physiologic activity. The three-dimensional spatial relation of the mandible is maintained and suspended in the visceral skull by the paired muscular synergisms and antagonisms which directly and indirectly invest it.

As added points of academic interest, it is interesting to observe that the anterior repositioning of the mandible is conducive to improving the con-

trolled efficiency in speech, respiration, and deglutition. In the process of the repositioning of the mandible, there is a widening of the nasopharyngeal aperture.

The indirect mandibular muscular influences antagonize the post-and prevertebral musculature, thus aiding in maintaining the position of the head in normal relation to the spinal column.

The musculature may be divided into the suprahyoid and infrahyoid groups. In the suprahyoid group are the muscles of mastication, namely, the paired temporal, internal pterygoids, external pterygoids, and the masseter muscles. The secondary muscles of mastication arise from the inner border of the mandible and extend to the hyoid bone. They are the paired digastric, geniohyoid, and mylohyoid muscles. The infrahyoid group of muscles extend from the hyoid bone to the thorax in front, they are the paired thyrohyoid, sternothyroid, sternohyoid, and the omohyoid muscles.

Figs. 7, 8, 9, 10, 11, and 12 show the changes that are brought about by the use of the palatal appliance in the adult patient. Some of these changes occur from six to nine months.

This appliance has numerous indications, such as:

1. Temporarily opening the bite for orthodontic procedures in maxillary overbite (unilateral, bilateral, or anterior).
2. Keeping the mandible forward (repositioning of mandible).
3. Opening the bite to allow for vertical development.
4. Depression of mandibular incisors in condition of a marked curve of Spee.
5. Preparation in bite raising and mouth rehabilitation.
6. Retention.
7. Relief of Costen's syndrome (clicking noise in condyle associated with pain).

Indications clinically of what appears to be over- or underdevelopment of either jaw in truth may etiologically be a reflection of muscular malcoordination.

My attempt to reposition the mandible is justified in the light of the clinical results observed and shown here. Coordinating the hyomandibular muscular mechanism with the supramandibular musculature effects integrated harmony, both in function and improved esthetics, and helps to preserve the integrity of the human economy.

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THE PREVENTION AND INTERCEPTION OF MALOCCLUSION

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DENTOFACIAL ABNORMALITY AS A PUBLIC HEALTH PROBLEM

THE value of orthodontic care to the physical and mental well-being and social adjustment of the child is being increasingly recognized by parents, educators, and the medical profession. As a defect existing in population groups, dentofacial deformity is of especial interest to public health authorities. This recognition has brought with it a growing demand for orthodontic advice and guidance, and has increased the active and latent demand for service.

There are approximately forty million children under the age of 16 years in the United States of whom seven to eight million need major orthodontic care and of whom less than four out of every one hundred who need it are actually receiving treatment. Orthodontists today are cooperating with health agencies on federal, state, and local levels in planning for the prevention, correction, and actual treatment of malocclusion to be paid for with government funds. We are destined in the future to hear more and more about "facial cripples."

As now practiced, orthodontic service cannot be provided on a universal basis under socialized, prepaid, or voluntary insurance dental plans because the classical methods of orthodontic procedure involve basic, irreducible costs which are prohibitive to a great section of our population. The hope lies in the early application of preventive measures to cut down the need for more extensive orthodontic treatment.

Orthodontics largely attempts to correct morphologic, numerical, and/or spatial deviations beyond the range of normal variation occurring in the arrangement of the teeth, in the occlusion of the dental arches, and in the relationship of the jaws.[1] Since the limits of normal dentofacial variation have not as yet been definitely established, there can be no general agreement as to what is or is not "normal."[2]

To prevent the occurrence of malocclusion in its true sense, it would be necessary to possess definitive knowledge of its etiological factors. We should have to be invested also with the ability and power to order the genetic endowment of the individual. Furthermore, we would have to be able to control antenatal, congenital, and postnatal development and function, and finally we would have to supervise and control the environment of the individual child at least throughout the developmental and growth period. The foregoing should fully satisfy the perfectionists who claim that it is impossible to prevent malocclusion.

Let us now come down to earth, as it were, and consider the child who is brought to our office and who sits in our dental chair.

When our patient opens his mouth—even before he does so, when we first glance at his face—we can frequently recognize that we are confronted with

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a specific condition which demands our attention. We cannot hide behind negativistic theories of semantic perfectionism. Our duty is to render service to our patients, to prevent the development of impending malocclusion, and to intercept and arrest incipient dentofacial abnormalities.

INTERRELATION OF PEDODONTICS AND PREVENTIVE ORTHODONTICS

Preventive and interceptive orthodontic measures, to be effective, must be applied early in the development of the child.[3] Since the young child is as a rule seen more frequently by the general dentist than by the orthodontist, it is essential for the general practitioner of dentistry to possess basic knowledge of the orthodontic principles involved in children's dentistry.

As to the combination of pedodontics and orthodontics, no one could logically oppose the practice of orthodontics by any dentist who has adequately prepared himself for it. However, the specialty of orthodontics does not lend itself well to combination with the practice of children's dentistry with its attending problem of pain control. Orthodontics in its best expression requires a continuing patient-doctor relationship wherein pain and fear of the operator must be eliminated if satisfactory results are to be achieved.

Wisan and Chilton[4] have shown that from an administrative point of view the private dental office is the least efficient method of providing dental service for children. It may well be that children's dentistry, instead of expanding to include the specialty of orthodontics, as has been advocated,[5] may largely be practiced in the future in public health clinics. The fact remains that the treatment of manifest malocclusion is a specialized service which requires definite postgraduate training, clinical experience, and skill, which can be developed only after years of application.

Prevention of malocclusion, like children's dentistry, has not obtained the wide interest of the general practitioner because dentists have not been sufficiently sensitized to the value of the orthodontic approach to their patients. Discussion between the orthodontist and the general dentist in the past has consisted largely of the orthodontist showing some "before" and "after" casts, especially the more spectacular kind, and in trying to impress the dentist with the fact that orthodontic procedure is a mysterious art which requires superior knowledge.

With few exceptions, articles on preventive orthodontics have been repetitions of long-known methods which allegedly restrain thumb sucking and other dentofacial habits, and on the construction of space maintainers. At the same time, criteria for the use of space-maintaining devices have received scant consideration in orthodontic literature.

Our failure to teach the dental practitioner the orthodontic entailments in every phase of his practice, whether it be filling of teeth, restoration of lost teeth, or the treatment of the soft tissues of the mouth, is largely responsible for the frequent misunderstandings between orthodontists and general practitioners with regard to the dental care of the orthodontic patient. Conversely, the lack of knowledge or lack of interest in modern procedure in operative and restorative dentistry on the part of most orthodontists mitigates against the cooperative effort of the general dentist and the orthodontic specialist.

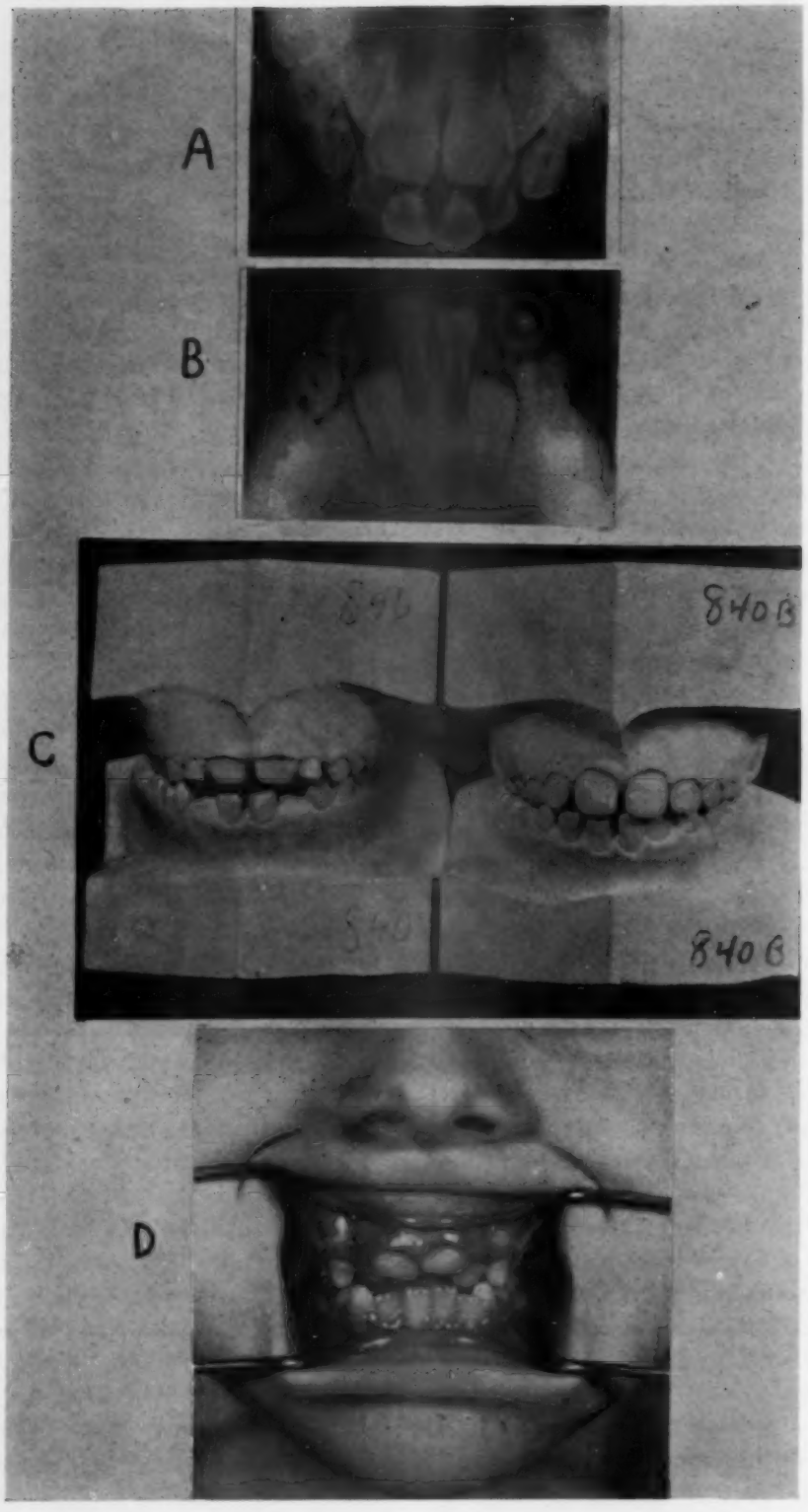


Fig. 1.—Occlusal roentgenograms of maxillary (*A*) and mandibular (*B*) dental arches at age 5 years, showing comparative size of deciduous and permanent incisors and canine teeth. *C*, casts show open-bite (left) at age 6 years, 6 months, and eventual closure of the open-bite (right) at age 8 years, as the incisors continued to erupt. *D*, a boy at age 8 years, 6 months, with maxillary permanent lateral incisors occluding in linguoversion. Early treatment is indicated.

Note.—The child's dentition, beginning with the eruption of the permanent teeth, is in a highly dynamic state. Development and growth changes in relation to time are important factors in the diagnosis of malocclusal tendencies.

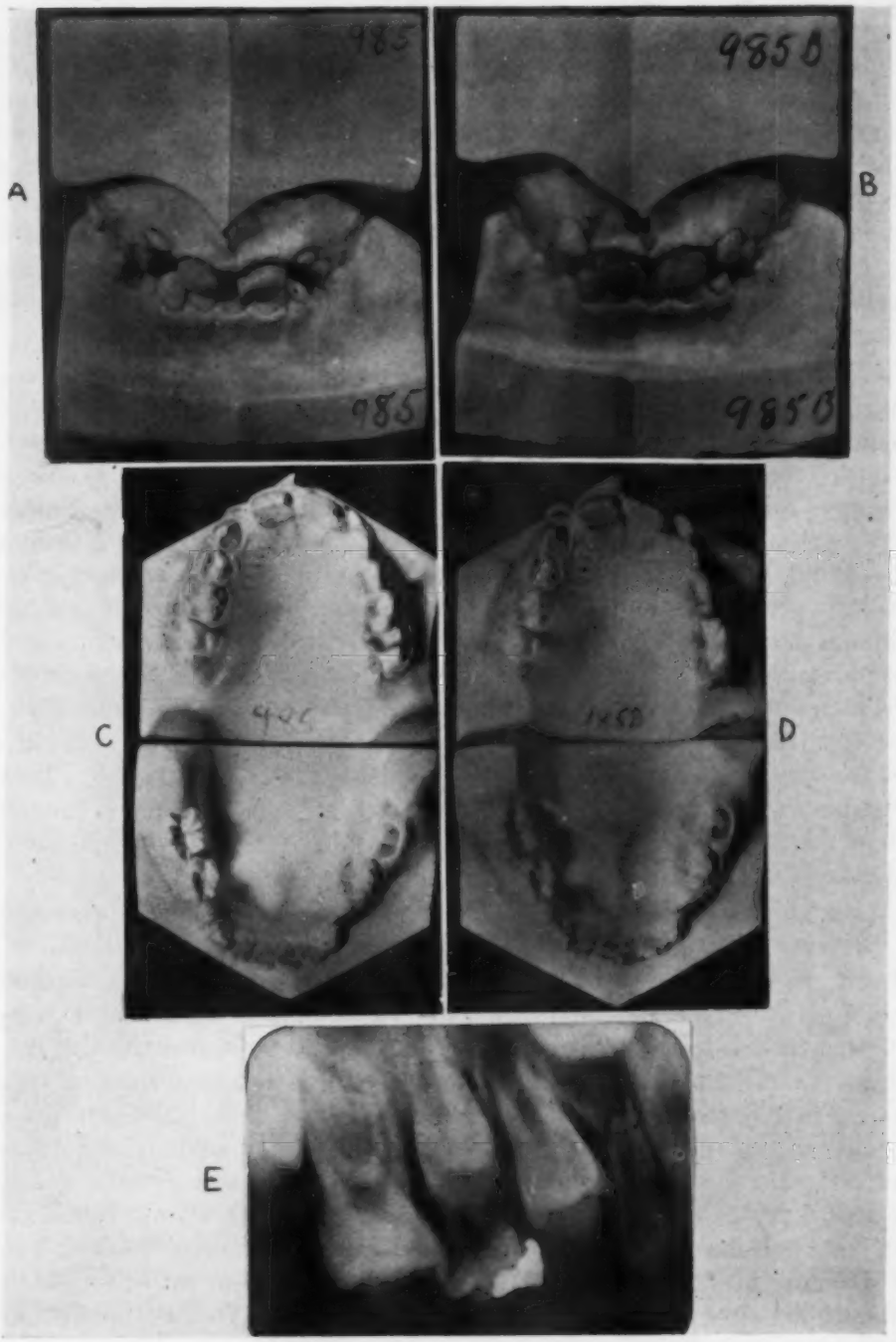


Fig. 2.—*A*, A pattern of eruption which at the age of 7 years shows separation of the permanent maxillary central incisors and insufficient space for erupting permanent lateral incisors. A diagnosis of malocclusion is not warranted at this time since natural growth and development usually overcome deficiencies of this type. *B*, the casts, made at the age of 10 years, show persistence of the early dental eruptive pattern with lack of development in the region of the maxillary incisors. *C*, occlusal view of the casts shown in *A*, at the age of 7 years, shows the maxillary left permanent first molar to be caught on the distal bulge of the crown of the second deciduous molar. The mandibular arch in *C* shows good development, and the spaces left after loss of the mandibular deciduous first molars show no signs of closing, although space maintenance by mechanical means was not attempted. *D*, occlusal view of casts shown in *B* at the age of 10 years shows exfoliation of the maxillary left deciduous second molar and partial closure of the space by forward shifting of the first molar. *E*, roentgenogram shows the maxillary permanent first molar caught on the partially resorbed crown of the deciduous second molar.

Note.—Space closure is due to shifting of the remaining teeth and is often pathognomonic of a constricted basal arch pattern rather than due to lack of growth induced by the deciduous tooth loss itself. Basal arch growth is independent of the presence or absence of teeth.

Many dentists have been known to examine the mouth without once asking the child patient to bring his teeth into occlusion or to move the mandible through its various excursive paths to determine traumatic and tipping interferences. Today the advice most frequently given parents by the family dentist, often without examining the mouth of the child and occasionally in reply to a telephone call, is that it is "too early" for their young child to receive orthodontic care. This advice is only too frequently followed some time later by the observation that it is already "too late" to prevent and frequently also to treat the malocclusion which has now fully established itself.[6]

A study by Seipel[7] indicates that some malocclusion is to be found in about 50 per cent of the population. The frequency is lower in the deciduous dentition, increases by about one-third during the mixed dentition period, and then tends to recede somewhat with the eruption of the permanent teeth. These differences are due to the fact that erupting teeth may appear to be and frequently actually are in a transitory state of malocclusion. A classic example is to be found in the "ugly duckling" stage described by Broadbent,[8] when the maxillary permanent central and lateral incisors are erupting and before the deciduous canines and molars are shed and replaced by the premolars and permanent canine teeth. Children undergoing these stages of development, we have been told, should be kept under observation over a period of time until these teeth are fully erupted and the occlusal adustments accompanying eruption are effected, before a diagnosis of malocclusion is established. However, if the observation of the general practitioner is to be worth anything to the patient, he must understand the principles of growth and development of the dental arches.

Lack of general knowledge of orthodontic principles is also the reason why the present increased interest in orthodontics among dental practitioners is directed chiefly to the desire for knowledge of the construction of orthodontic appliances which the general practitioner today regards as the most important part of orthodontics. In this false premise, the general practitioner has been indirectly abetted by the specialists in orthodontics who have through the years emphasized "systems of appliance therapy," rather than basic principles. As a result of this misunderstanding, many dentists are undertaking to correct manifest malocclusion without adequate preparation and frequently without any knowledge at all of orthodontic principles. The reaction is bound to show itself in inadequately treated, if not also in unnecessarily treated, patients. The specialty of orthodontics has a public relations job of prime importance on its hands, not only with the public, but also with the rest of the dental profession.

THE MANIFESTATION OF MALOCCLUSION

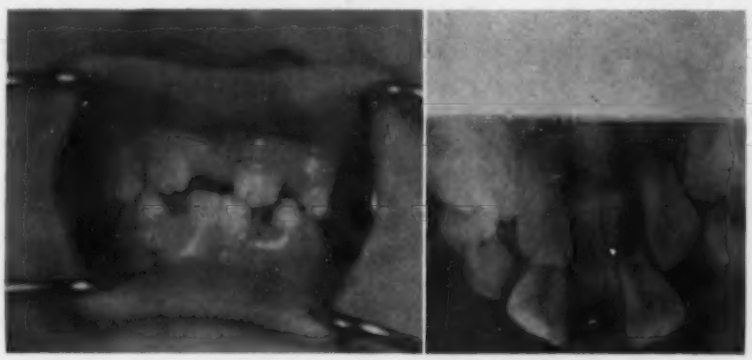
Malocclusion in the child population consists in decreasing frequency, as follows:

1. Intramaxillary crowding, due mainly to lack of alveolar growth and other local interferences with normal tooth eruption and coronal arch development.
2. Intermaxillary dental occlusal malrelationships with or without jaw malrelationship, especially as seen in Angle Class II types,

chiefly in the form of excessive, horizontal overjet and vertical overbite.

3. Disproportions in over-all jaw development and growth without or with minor dental irregularities.
4. A combination of dental irregularities and lack of or disproportion in over-all growth, development, and relationship of the jaws, including the basal arches.

Variations in tooth position in the dental arches express themselves clinically in the form of crowding, spacing, rotations, proximal contact alterations, and changes following too early shedding, prolonged retention, supernumerary congenitally missing teeth, and extraction of teeth. In the deciduous dentition, spacing predominates, while crowding is to be found more frequently in the permanent dentition. Seipel[7] found the frequency of spacing to be comparatively evenly distributed among the sexes. At the age of 4 years the maxillary arch shows slight spacing, especially about the canine region. This has been recognized as the "primate type" of spacing. About the age of 5 years, the well-recognized interdental spacing makes its appearance, but may be absent in some children.



A. *B.*

Fig. 3.—*A*, Unusually wide diastema between the maxillary permanent central incisors before eruption of the permanent lateral incisors. *B*, roentgenogram of the same patient shows little if any root formation on the erupted tooth crowns of the central incisors. Closure of the diastema may be undertaken after the roots of the central and lateral incisors are approximately two-thirds formed.

In the deciduous dentition, crowding and spacing in the same jaw may be accepted as a frequently occurring developmental variation. In the permanent dentition, this phenomenon is to be regarded as a symptom of tooth migration and defective eruption following local interferences, mostly in the nature of early loss or prolonged retention of deciduous teeth. Rotation of teeth is usually a concomitant of crowding, but occurs also in cases in which the space usually allotted for a tooth is so large as to interfere with the establishment of proximal contact between the erupting tooth crown and the adjacent teeth.

In the permanent dentition, spacing in the maxillary jaw is usually localized from canine to canine. Spacing at the median line between the maxillary central incisors may be due to type as well as to an abnormal labial frenum. Mandibular incisors in the permanent dentition after attaining full eruption show a tendency to increased crowding with increase in age.[9]

Anomalies of tooth arrangement attributable to postnatal environmental or local causes are largely preventable, and they predominate in early childhood.[10] Growth of the jaws, development of the teeth, and establishment of the occlusion follow a genetic pattern but are influenced by congenital and postnatal factors which may, in turn, themselves be of genetic origin.[11] Intermaxillary jaw relationship is of a stable individual character which, once it is established, tends to be maintained during tooth change and jaw growth. Lack of jaw growth can be diagnosed with certainty only at a later period in the development and growth of the child, and is in the main not preventable and is unresponsive to orthodontic therapy.

BASIC PRINCIPLES IN DIAGNOSIS OF MALOCCLUSAL TENDENCIES

In the examination of the patient we have available various armamentaria and disciplines. To forego the use and advantages of any of these, e.g., roentgenograms, casts, photographs, direct facial measurements, general dental and medical history, and other items which enter into the appraisal of the dental and orthodontic status of the patient, is to handicap ourselves in establishing a correct diagnosis.

There is one important diagnostic factor available to us which is often overlooked when examining the child. I refer to the factor of time which, as pointed out elsewhere,[12] constitutes a fourth dimension in orthodontic diagnosis. A knowledge of the development of the dentofacial complex in the three dimensions of space through the interval of time is the keystone of orthodontic science and art. However, in order to gauge the change through time and space in the development of the individual, we must have available definitive knowledge as a base which can be used for comparative purposes. Furthermore, we must know how to employ this knowledge, not merely in relation to "standards," but in its application to the development of the dentition of the individual patient,[2] the child who sits in our dental chair.

While the course of skeletal growth is primarily determined by genetics, the pattern of growth may be modified or retarded by hormonal, nutritional, or pathogenic disorders occurring during the growing period which interfere markedly with the health of the organism.[13] Gregg (1941)[14] called attention to the effect of rubella (German measles) in the mother during early pregnancy on congenital deformity of the child. Congenital deformities may be acquired or inherited.[15] When dominantly inherited, they are found to occur in significant numbers in the family tree. Recessive traits require more comprehensive study of the family history and background. While inherited anomalies are related to the chromosomes and may show themselves at any time during the life cycle, acquired defects are related in turn to the stage of development when they originate. Both genetic and acquired factors acting together can be considered as causative agents in certain dentofacial anomalies.

Endocrine imbalance is a factor in dentofacial maldevelopment, and endocrine therapy is important in the prevention and interception of malocclusion. However, many of the dental stigmas formerly thought to be associated with or accepted as criteria for the diagnosis of endocrine imbalance have been discarded with the increase of factual scientific knowledge.[16] It is now generally

recognized that while disturbances in the direction and rate of jaw growth do occur, an atypical eruption is frequently pathognomonic of endocrine deficiencies. In hypophysectomized animals, the deciduous teeth are retained. In some endocrinopathies the teeth suffer because of changes in the periodontal tissues and general systemic disturbances as in parathyroid insufficiencies where the blood calcium is reduced. Endocrine disturbances may be transitory as well as subclinical.[17] At the same time, they may leave their mark on the development and the occlusion of the dentition.[18] However, to claim that tooth size and shape are pathognomonic of endocrine disturbances is to enter the realm of conjecture.

DENTOFACIAL PRESSURE HABITS AND THEIR TREATMENT

Preventive measures in orthodontics can be instituted even before the teeth actually erupt in the mouth. Malocclusion can be initiated by improper selection of a feeding nipple in the bottle-fed baby and by improper position of both the infant and the bottle during the feeding period.

It has been suggested that a nipple long enough to rest on the anterior third of the tongue be used and that small openings be punctured in the sides of the bulb of the nipple instead of at the end only, to prevent the infant from squirting the milk directly into the pharynx.[19] With this method there would be less tendency toward hurried feeding, and less air would be swallowed by the infant along with the milk.

Mouth breathing and sleeping positions as primary causative factors in malocclusion have lately met with critical opposition. Gwynne-Evans[20] attributes mouth breathing to the persistence of the infantile facial pattern. He believes that mouth breathing is not necessarily always secondary to nasal obstruction but that it is a manifestation of delayed maturation of the functional behavior of the facial and oral musculature.

Hartsook[21] concludes that mouth breathing is not a primary etiological factor in the production of malocclusion, and cites the fact that malocclusion in mouth breathers is distributed among all of the Angle classifications and is not limited to one form of malocclusion, namely the Class II, Division 1 (Angle) type, as commonly accepted. The occurrence of various types of malocclusion in mouth breathers does not negate mouth breathing itself as a primary causative factor.[22] Where allergic involvements, certain local growth deficiencies, or dentofacial habits are present, or where untoward swallowing or tongue-thrusting habits exist, malocclusion in mouth breathers may be modified accordingly. In allergic children who are also mouth breathers, the maxillary incisors may show characteristic crowding. In finger-sucking mouth breathers, there usually is an open-bite. In mouth breathers with extreme distal position of the mandible, the mandibular incisors may occlude far back on the rugae of the palate. Extreme dental irregularity may also be found in mouth breathers who have an underdeveloped maxilla, especially of the premaxillary segment, and a constricted basal arch. These types usually also show open-bite of varying degrees.

Whether or not mouth breathing is a primary cause of malocclusion is relatively unimportant. The fact remains that in the mouth breather a muscle

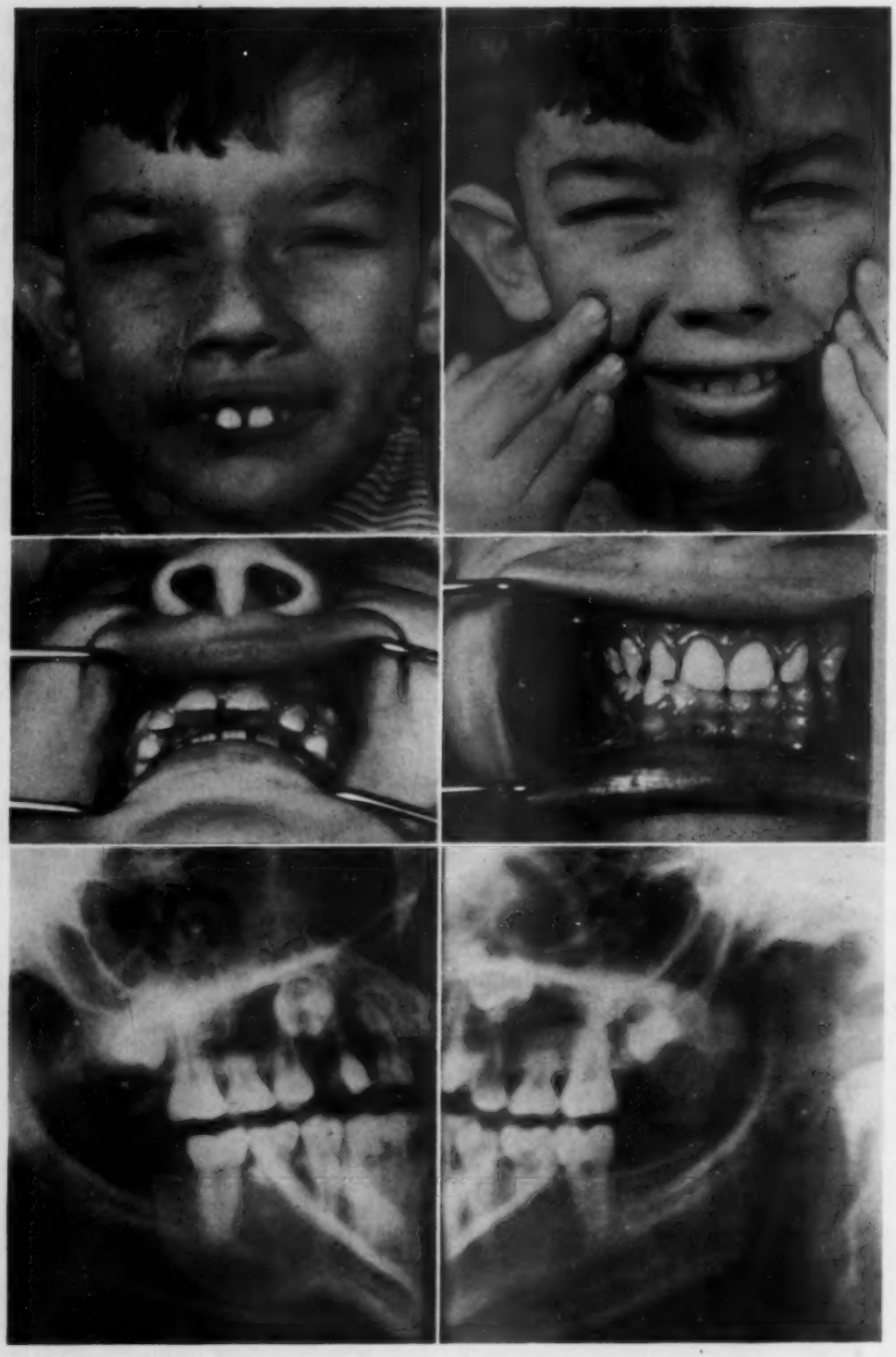


Fig. 4.—*A*, A boy aged 9 years, with partial anodontia, protruding maxillary permanent incisors, and slight mongoloid facies. *B*, the same boy with characteristic mongoloid imperfection of middle phalanges and shortening of the little fingers. This boy was unusually alert and mentally above normal. *C*, close-up of anterior overbite. *D*, occlusion after treatment. *E*, lateral jaw roentgenograms of same boy shown in *A*, at age 13, showing congenital absence of the maxillary and mandibular second premolars: the maxillary third molar tooth germs are absent as are the mandibular second and third molar tooth germs. *F*, profile roentgenogram before orthodontic tooth movement. *G*, after orthodontic treatment was completed.

Note.—Use of the vestibular plate cut down the length of treatment and the prolonged use of fixed appliances which may have interfered with the retention of the deciduous teeth.

F.

G.

Fig. 4.—*F* and *G* (For legend, see opposite page).

complex is present which tends to produce narrowing of, or interference with, the lateral widening of the maxillary dental arch.[23] When the lower lip in the mouth breather falls lingual to the normally erupted maxillary incisors, protrusion of the maxillary incisors and narrowing of the lateral segments of the dental arches are encouraged.

With regard to sleeping position, it is well known that the infant does not lie in one position during sleep, but moves about at frequent intervals. These movements are largely involuntary and are produced by nervous reflexes in order to obviate pressure interference with circulation. Before sleeping position can produce any deleterious effect on jaw growth, the child would have to be suffering from some osteogenic deficiency or he would have to be overdressed or covered in such a manner as to make it almost impossible for him to change his position during sleep. In the final analysis, in order for pressure to influence jaw growth, the force of pressure exerted on the jaw would have to be greater than the total component of stress which the jaw can withstand.[2] This is also the reason why activated orthodontic appliances attached to the teeth initiate changes in tooth position but do not produce over-all changes in jaw growth.

The effect of posture during the waking hours of the child is more important than position during sleep in the production of dental malocclusion.[24] Posture during waking hours has been considered by Rogers[25] in his work on myofunctional therapy. In general, however, posture has not received sufficient attention from orthodontists as a causative factor in malocclusion.

The act of swallowing is often perverted in children and is frequently responsible for the establishment of malocclusion. Atypical swallowing is attended by perverted muscular function which produces changes in jaw development and malocclusion. Rix[26] described typical swallowing as taking place with the jaws and teeth brought together and the tongue thrust against the lingual surfaces of the occluded teeth and the palate. The tongue functions best during the swallowing act when its tip and sides can be braced against the rigid hard palate and the occluded teeth. In atypical swallowing, where the tongue is thrust between the partially separated dental arches, it seeks to brace itself against the lips which are contracted and made rigid with the aid of the mentalis muscle. Rix[26] found over 80 per cent of atypical swallowers to show malocclusion of the teeth. Self-cleaning of the teeth after eating is poor in atypical swallowers and tends to produce a higher incidence of dental caries. Atypical swallowing and tongue-thrusting are difficult to overcome. The earnest cooperation of the patient and parent is of utmost importance in breaking these habits.

Thumb sucking and finger sucking, in addition to their effect on the occlusion of the teeth, have been blamed for producing various pathologic conditions in children, such as gastrointestinal disturbances, respiratory infections, and stomatitis. Backwin[27] states that children who persist in sucking their thumb after the fourth month of life may be looked upon as finger suckers, and excessive practice of the habit may be regarded as an indication of an unsatisfactory

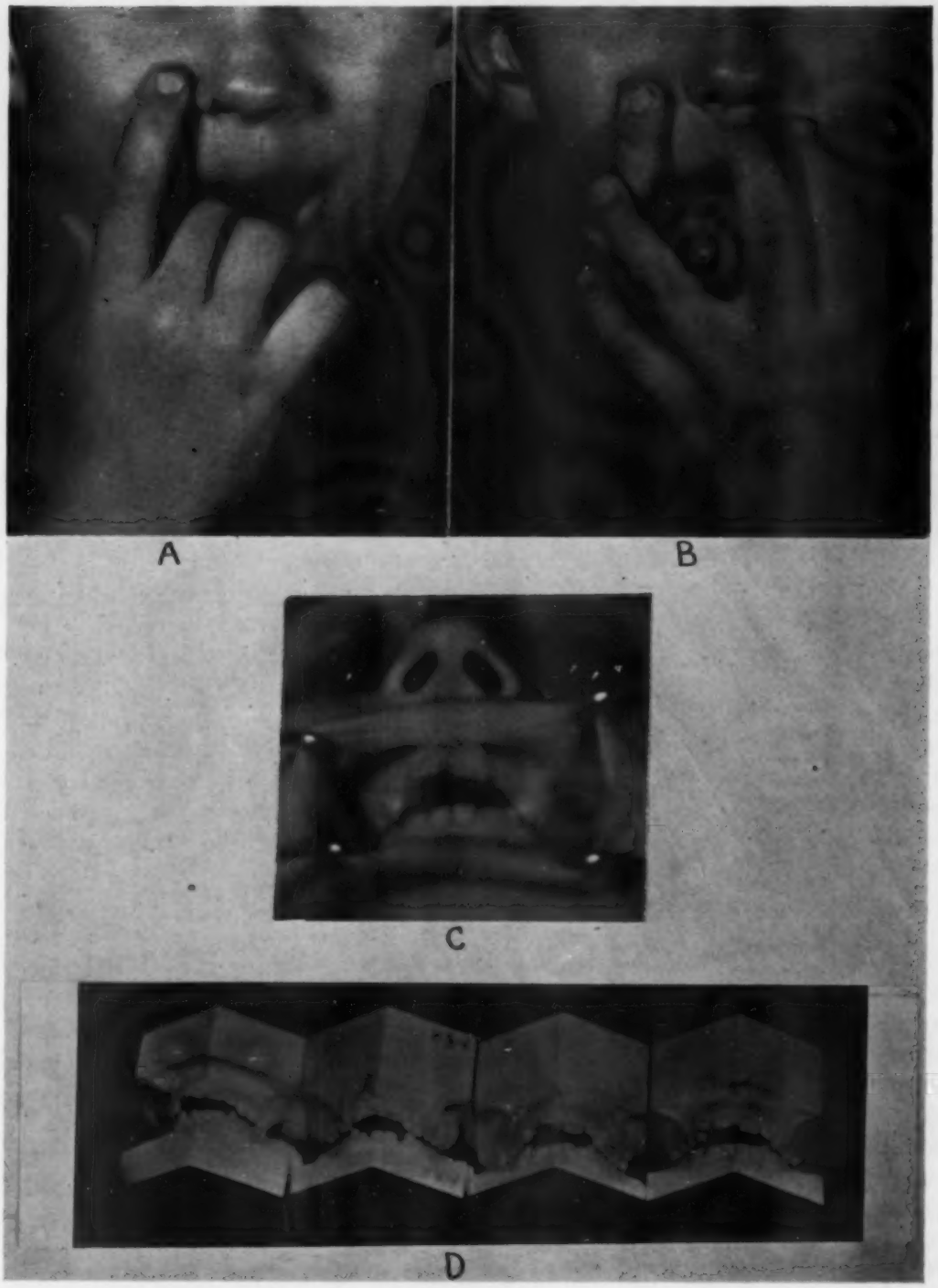


Fig. 5.—*A*, Boy who sucked his second and third fingers of the right hand. This was covered by the left hand (*B*) while the middle finger of the left hand was used to tap on the lip at the philtrum; *C*, malocclusion at age 8 years, 6 months, induced by the continued finger sucking; *D*, casts at age 5 years, 6 years, 7 years, and 8 years, 6 months, respectively.

Note.—There is no self-correction as long as the habit is continued and/or the lower lip rests lingual to the maxillary incisors.

psychologic adjustment. Tongue and lip sucking or biting may have the same psychogenic origin as finger sucking, and are frequently seen to occur in restrained finger suckers.[28]

As to the effect of sucking habits on the maxillary and mandibular bones and the dental arches including the occlusion of the teeth, it should be kept in mind that the frequency with which the habit is practiced, the duration of time that the habit has lasted, the osteogenic development and genetic endowment of the child, the general state of health, and other factors are important contributory causes in determining the presence, type, and severity of the malocclusion.

It is logical to assume that where local conditions favor changes in the supporting bones of the teeth, the pressure caused by the thumb, fingers, tongue, or lip will produce changes of a malocclusal nature.[29] When the maxillary incisors are displaced in a forward direction, the alveolar process, which is the support of the teeth, also becomes displaced and enlarged. If the lower lip falls lingual to the maxillary incisor teeth, it continues their forward displacement. Furthermore, continued pressure of the hand against the chin during the finger-sucking process may well produce a change in the over-all direction of growth of the mandible or displace it bodily in a distal direction. It is harmful to dismiss sucking habits as having no bearing on the production of malocclusion.

Perhaps the most dangerous effect of finger and thumb sucking is the parental nagging which sets up conflicts between the child and the parents. Such parent-child relationship interferes with the motor development of the child and develops a negativistic attitude in the child. A personal appeal to the child, preferably by someone other than the parent, to obtain the child's cooperation in eliminating the habit is important. The child is thus given a sense of responsibility in the habit-breaking process. It may well be that some of the sucking habits, especially in young children, are normal expressions and have no psychosomatic involvements.

Nail biting (onychophagy) was reported in a survey of 100 nail-biting children, aged 6 to 19 years, by Schachter and Cotte.[30] They found that 13 per cent had suffered from early convulsions, 9 per cent from premature eruption of the dentition, 20 per cent from nocturnal enuresis, 34 per cent from slight mental deficiency, and 26 per cent from serious mental deficiency. These authors express the opinion that local treatment of the symptoms alone is of no avail; that the habit is a condensed manifestation of multiple motives and deficiencies and that it is necessary to study the child's physical, mental, and social difficulties if the roots of the habit are to be removed. However, some nail biting of a transitory nature, frequently in imitation of other children, is commonly found in early adolescence. Arousing a new interest in the fingernails such as the application of fingernail polish has been found helpful in girls. Boys may be appealed to on the basis of good sportmanship or reward for effort in sparing the nails of an increasing number of fingers. The study of the psychoneurotic make-up of the child is of great importance. The orthodontist should not attempt to practice amateur psychiatry on his child patients, unless he has special training in this field.

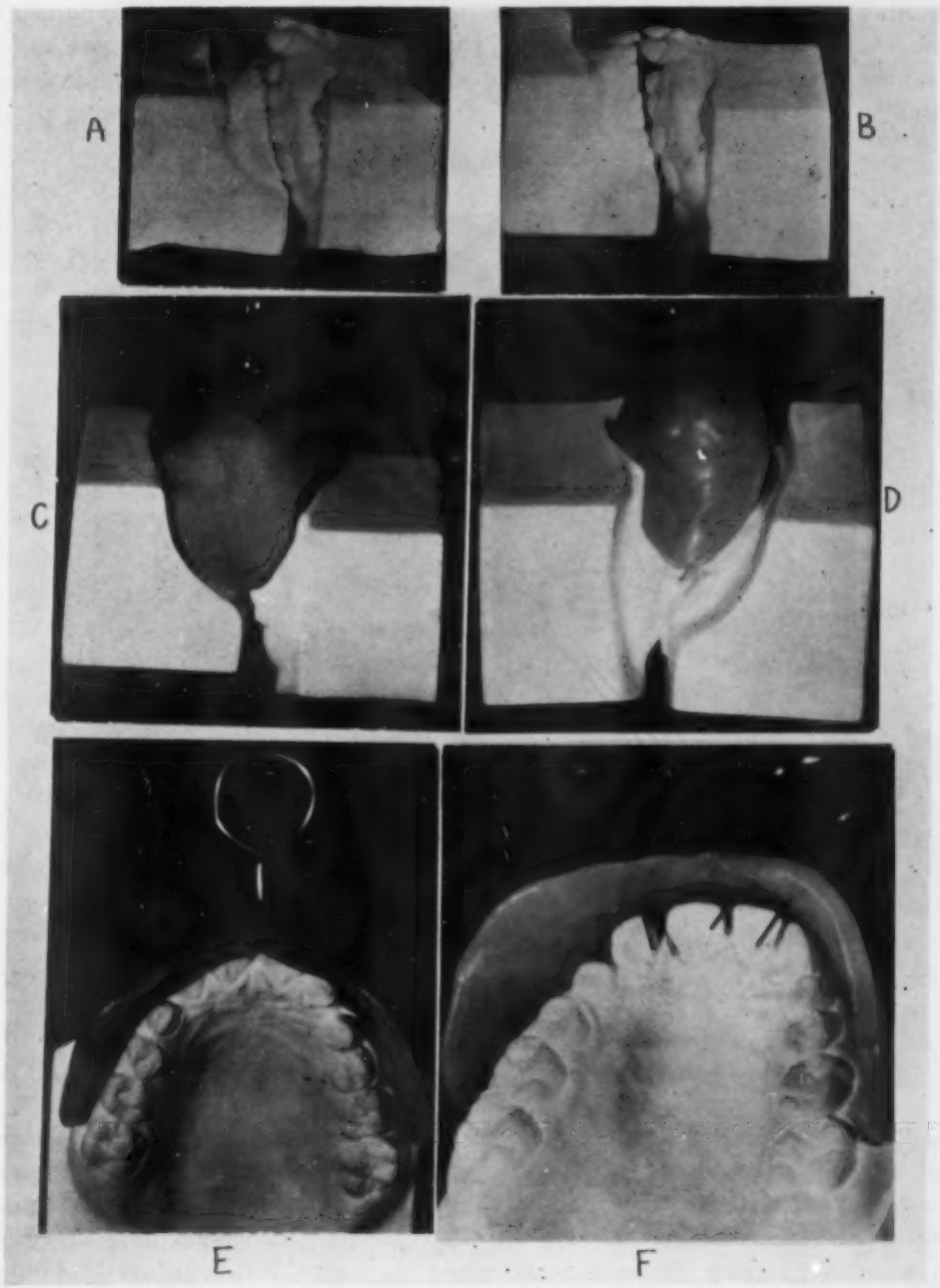


Fig. 6.—Construction of the vestibular plate. *A*, Casts show protrusion of the maxillary central and lateral incisors; *B*, duplicate casts with the mandibular cast raised to approximate the maxillary incisors prior to the construction of the vestibular plate; *C*, vestibular plate constructed of two thicknesses of pink basewax with wire handle inserted; *D*, vestibular plate in position with casts approximated in proper relationship; *E*, occlusal view showing the vestibular plate fitted to rest on the incisor teeth; *F*, anterior view of vestibular plate with wire prongs inserted to overcome tongue thrusting and resultant open-bite.

Before nasal breathing can be encouraged in mouth breathers, it must be ascertained that it is possible for the child to breathe through the nose. Nasal breathing should be practiced after strenuous exercise. Masseter-temporal and other exercises described by Rogers[31] should be instituted. Purposive mouth breathing, finger sucking, or lip biting in front of a mirror (the Dunlap Beta method[1]) may be practiced to bring the habits into the consciousness of the child.

Fig. 7.—*A*, Completed vestibular plate; *B*, vestibular plate in position; *C*, method of using vestibular plate for exercising the orbicularis oris muscle.

Providing the child with a teething ring during the latter half of the first year may help to break the thumb- or finger- sucking habit. Levy[32] found finger sucking to be more common among infants who were fed at more widely spaced intervals, although Gesell and Ilg[33] believe that inadequate sucking is not a primary cause in pathogenic finger sucking. Bitter substances on the fingers may be used with the consent of the child as a reminder not to suck the thumb or finger.

With the cooperation and consent of the child, an appliance may be inserted into the maxillary jaw which interferes with the insertion of the thumb, finger, or lip in its accustomed place. Such appliances which employ spurs, whether stationary or removable, have been described in orthodontic literature.

The use of an oral screen worn at night has been advocated for overcoming pressure habits.[34] The screen can be made of plastic or metal. It is fitted to the oral vestibule between the lips and the teeth and gums. To construct the screen, impressions are taken of the upper and lower dental arches, making certain that all of the vestibular surface to the mucobuccal fold is included. Casts are poured and related as near to normal occlusion anteroposteriorly as possible by bringing forward the mandibular cast. The screen is constructed of two thicknesses of wax, extending from the maxillary to the mandibular buccal fold, skirting the muscular frenums, and going as far distally as the distal cusp of the permanent first molars. The waxed screen is then pulled slightly away from the buccal dental segments and made to rest on the protruding anterior teeth. If the screen is to be used also for lip exercises, a wire ring is inserted on the labial surface at the level of the edge of the upper lip.

Re-establishment of normal muscle tone of the lips usually follows the orbicularis oris exercise by means of the screen. Insertion of the screen should be made by the child himself.

INTERCEPTION OF MALOCCLUSAL TENDENCIES

The correction or interception of malocclusal tendencies at an early age may not prevent the occurrence of malocclusion from other causes at a later age. Early treatment should be instituted for the purpose of obtaining the maximum benefits of function in order to achieve the genetic growth and developmental potentialities of the child. More than one period of orthodontic treatment may actually be necessary because new interferences and disbalances in arch and/or jaw relationship may manifest themselves in later childhood.

Maintenance of the deciduous dentition in a healthy state until these teeth are shed is a primary influence in the prevention of malocclusion.[35] Timely, topical application of sodium fluoride and filling of deciduous teeth are important not only for the prevention and elimination of oral infection but also for alveolar growth and proper establishment of the coronal arch and normal occlusion of the permanent teeth. Malocclusion can be initiated by the child when he favors one side of his jaw to avoid chewing on carious teeth or to obtain tooth contact when some of the teeth have been extracted.

Early recognition of ectopic eruptive tendencies of teeth, the presence of supernumerary and malposed teeth and congenitally missing teeth are important factors in prevention of malocclusion.[36] Timely extraction of a supernumerary or of a deciduous tooth past the physiologic age when it should be shed is sufficient to intercept some malocclusions.[37]

Lingually occluding maxillary incisors or, conversely, labially occluding mandibular incisors should be diagnosed from the standpoint of sufficient space and arch deviation. Self-treatment advice to the patient by the use of tongue blades is at best haphazard and may be attended by danger to the occlusion of the teeth in general.

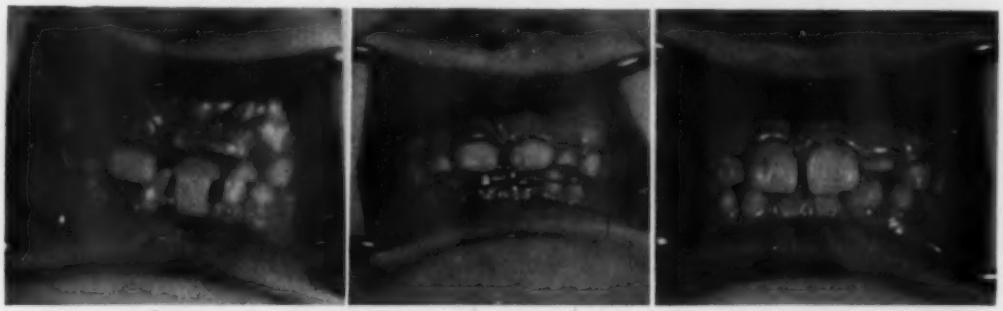
In dentitions where one erupting permanent incisor tooth actually displaces two deciduous teeth, the entire dental arch should receive early attention in order to offset extreme crowding of the permanent teeth later.

Fig. 8.—*A*, Erupting maxillary first premolar is interfered with by the prolonged retention of the deciduous first molar; *B*, maxillary protrusion produced by prolonged retention of the deciduous teeth which interfered with occlusal adjustment of the erupting permanent teeth. The lower lip was later caught under the maxillary incisors when the teeth were approximated and the malocclusion became more definitely established; *C*, a girl, aged 15 years, showing bulging of the mucosa over the maxillary permanent lateral incisors caused by ectopism of the permanent canines. The deciduous canines are still in position; *D*, same patient as in *C* after treatment. *Note.*—This patient had numerous fillings and visited her dentist regularly, but correction of the ectopism of the canines was not suggested.

E, Girl, aged 18 years, showing prolonged retention of mandibular left deciduous lateral incisor, irregularity of the permanent mandibular incisors, and congenitally missing maxillary permanent lateral incisors. *Note.*—This patient visited her dentist regularly and had many fillings in her teeth. No suggestion was made to correct the malocclusion. *F*, Retention of mandibular deciduous incisors in a girl aged 18 where the permanent mandibular incisors were congenitally absent.

Cheyne and Wessels[38] studied resorption of the roots of the deciduous second molar following eruptive pressure of permanent first molars. The consequent space loss and mesial shift of the permanent first molars were responsible for initiating malocclusion.

A deeply locked permanent first molar requires extraction of the deciduous second molar, and space opening or maintenance for the accommodation of the oncoming second premolar. In cases where the locking is light, disking of the distal bulge of the deciduous second molar or unlocking of the permanent

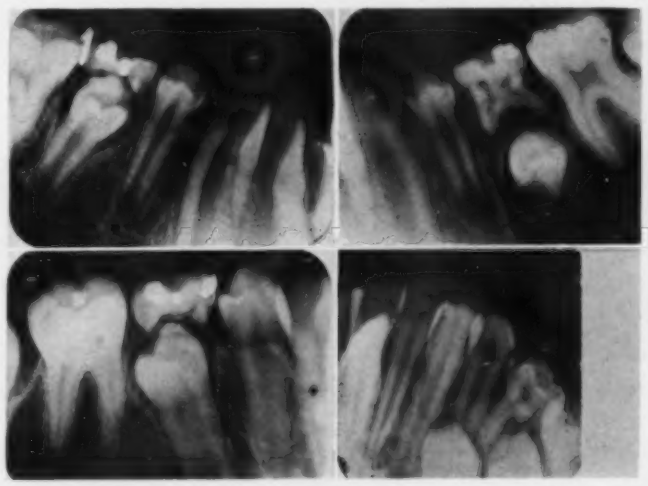


A. *B.* *C.*

Fig. 9.—*A*, Anterior cross-bite in a girl aged 7 years. *B*, mandibular labial arch used to hold the mandibular central incisors stationary while the maxillary incisors continued to erupt. *C*, maxillary central incisors of the girl shown in *A*, in labial occlusion.

Note.—There was no appliance used on the maxillary teeth.

A. *B.*



C. *D.*

Fig. 10.—*A*, Roentgenogram showing extreme resorption of the right mandibular deciduous second molar with the succeeding second premolar ready to erupt. *B*, roentgenogram of the left side of the patient shown in *A*, showing little resorption of the roots of the second deciduous molar, and the crown of the succeeding second premolar is only partially formed.

Note.—The rate of root resorption of deciduous teeth and development of the permanent teeth on each side of the jaw of the same patient may show extreme variation. *C*, roentgenogram showing ankylosis of the alveolar process with the crown of the deciduous second molar after the roots were resorbed, causing prolonged retention of the deciduous molar and interference with the eruption of the second premolar. *D*, roentgenogram showing failure of resorption of the root of a mandibular incisor tooth interfering with the proper occlusal alignment of the permanent incisor.

Note.—Deciduous incisors may fail to show root resorption and can act as mechanical interference to the eruption of permanent teeth.

first molar by means of ligatures or spring traction is indicated. In all cases, the general development of the dental arches, the arrangement of the teeth, and their effect on facial appearance are to be taken into consideration before the method of treatment is decided.

Fig. 11.

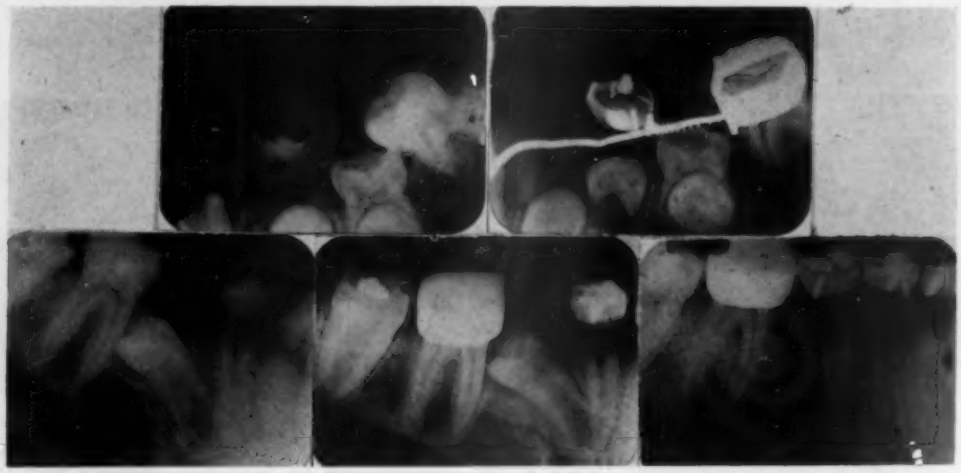


Fig. 12.

Fig. 11.—*A*, Roentgenogram shows submergence of the deciduous second molar which is now below the line of occlusion of the deciduous canine and first molar. This can be caused by extreme mesioaxial inclination of the erupting permanent first molar which depresses the deciduous second molar. *B*, roentgenogram shows appliance with coil spring opening space for the deciduous second molar which was subsequently removed and the space retained for the eruption of the second premolar.

Fig. 12.—*A*, Roentgenogram showing ectopism of second premolar. *B*, roentgenogram showing appliance with coil spring moving first molar distally and inducing eruption of the second premolar. *C*, second premolar, now in position, has been banded in the course of general orthodontic treatment.

Note.—Surgical interference to uncover ecoptic teeth is not necessary when the overlying bone shows resorption, and treatment is started not too far beyond the physiologic eruption age of the tooth to be brought into occlusion. The insertion of hooks into ectopic teeth to bring them into occlusion is as a rule unnecessary.

Cross-bites, as is well known, should receive early treatment as soon as diagnosed. The definite position and extent of the temporomandibular articulation and the form of the glenoid fossa are determined by the occlusion of the teeth. If the occlusion is in cross-bite relation, a lateral deviation of the mandible may be established. However, the method of treatment, i.e., the appliance to be used, presents an important decision. In the deciduous dentition between the ages of 3 and 5, fixed appliances may be used. In the mixed dentition, removable appliances which will not interfere with the natural eruptive process of the permanent incisors and other teeth are indicated. In posterior cross-bites, especially in the mixed dentition, cross elastics may not prove efficient because, while normal tooth alignment may be achieved in this manner by moving and aligning the individual teeth to which the cross elastics are attached, while the bodily position of the mandible is allowed to remain in lateral deviation. The use of a monoblock is widely resorted to in some European countries.

Light orthodontic force has been advocated as a method for obtaining arch expansion in the early mixed dentition period.[39] However, in view of the work

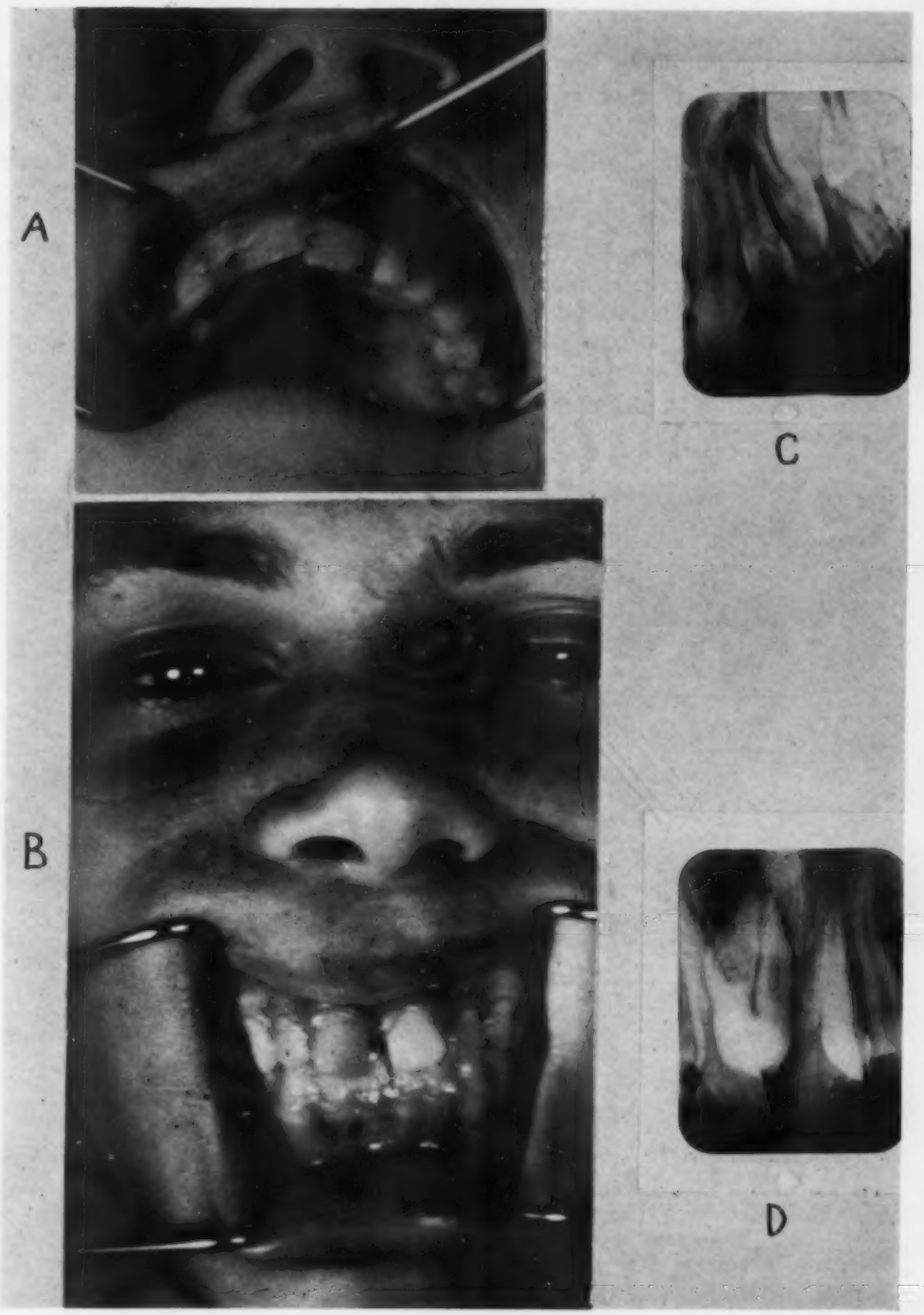


Fig. 13.—*A*, Occlusal view showing duplication of maxillary deciduous left lateral incisor in a boy aged 7 years, 6 months; *B*, malocclusion induced by the presence of an odontoma and supernumerary tooth in a boy aged 15 years; *C*, roentgenogram showing unerupted duplicate permanent lateral incisors in addition to the erupted duplicate deciduous lateral incisors. The permanent lateral incisor on the right is erupted (*A*). *D*, roentgenogram showing an odontoma and a conical supernumerary in the maxillary incisor region of the boy shown in *B*.

Note.—An erupted supernumerary tooth in good alignment may be allowed to remain in the mouth when the occlusion is not interfered with esthetically or functionally. Supernumerary teeth interfering with eruption or tooth alignment should be extracted. Malformed supernumeraries, especially in the anterior part of the mouth, which cannot be restored by prosthesis, should be extracted.

of Nance,[40] it is questionable whether such expansion is of a permanent nature. Differentiation should be made in these cases between buccal movement of teeth in linguoversion and those properly aligned but which still do not allow for the regular arrangement of all the permanent teeth in normal occlusion because of a deficiency in the basal arches.

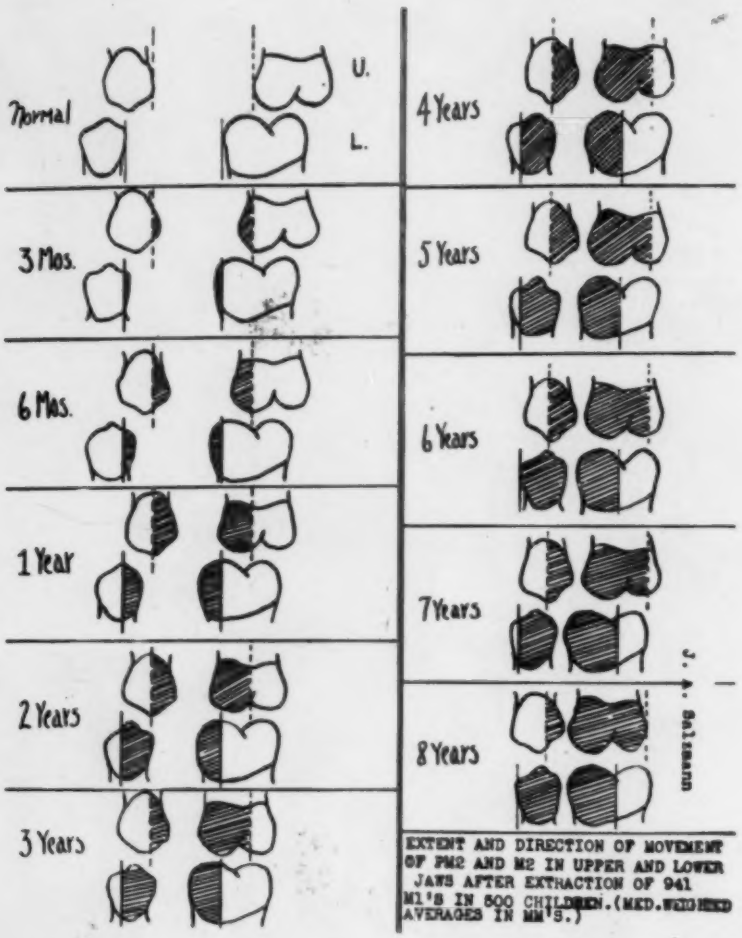
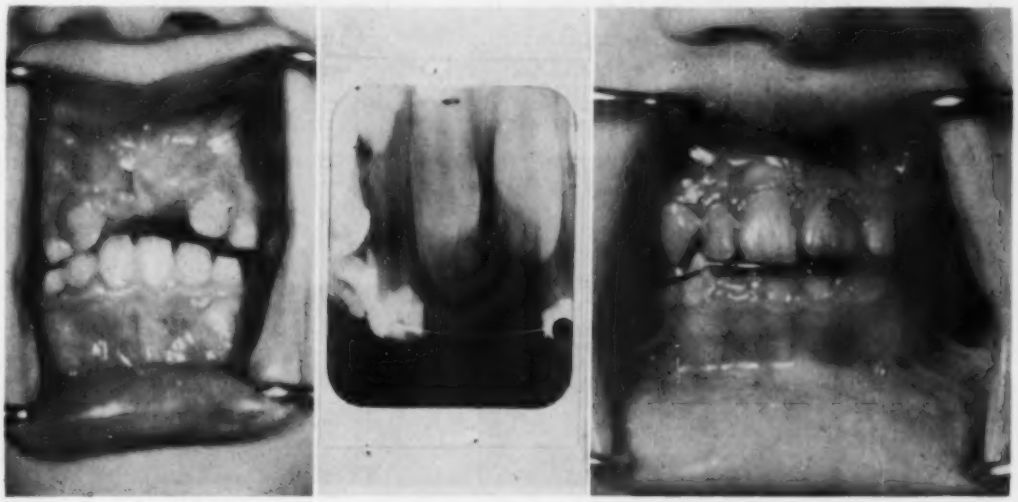


Fig. 14.—Amount and direction of shifting of the second premolar and second molar in the maxillary and mandibular jaws in effecting space closure at different intervals after the extraction of first molars. (Based on 941 first molar extractions in 500 children, computed on median weighted averages in millimeters.)

Morgan[41] observed 100 cases of supernumerary central incisor teeth. He found them to be responsible for delayed eruption, noneruption, and spacing of the permanent teeth. Early removal of supernumerary teeth is important to prevent crowding and other dental irregularities and dental arch malrelationships. Where a supernumerary tooth of the duplicate type is found in the permanent dentition with the teeth in regular alignment, there is no valid reason for its extraction, provided the occlusion is not too greatly interfered with or removal would involve major orthodontic tooth movement.

It is now accepted procedure, if maxillary lateral incisors are congenitally missing, to move the canines and the teeth in the lateral segments of the maxillary arch distally and then to replace the missing lateral incisors by artificial substitutes.

In the case of missing mandibular premolars, the arrangement of the teeth in both dental arches must be taken into consideration before the decision is made as to whether the deciduous teeth without permanent successors should be allowed to remain in the mouth. In extremely crowded dental arches, it is best to determine whether the growth of the jaws will permit retention of all teeth in regular alignment and in good occlusion without bimaxillary dental protrusion before space opening is attempted. In crowded dental arches with constricted basal arches, the deciduous teeth should be extracted and advantage taken of the spaces left to arrange the crowded teeth in normal alignment.



A. *B.* *C.*

Fig. 15.—*A*, Failure of eruption of maxillary central incisors due to a hematocyst following injury in a boy aged 10 years. *B*, roentgenogram showing space opening by orthodontic means after removal of the hematocyst. *C*, central incisors in position.

Note.—Early diagnosis and treatment could have prevented space closure.

When a maxillary premolar is unerupted and the space is closed, and the alignment of the teeth in the mandibular jaw, whether because of an insufficient basal arch or because of congenitally missing teeth, contraindicates the retention of both premolars in the maxillary dental arch, the unerupted premolar tooth is the one to be extracted in the maxillary jaw, in order to facilitate normal tooth alignment.

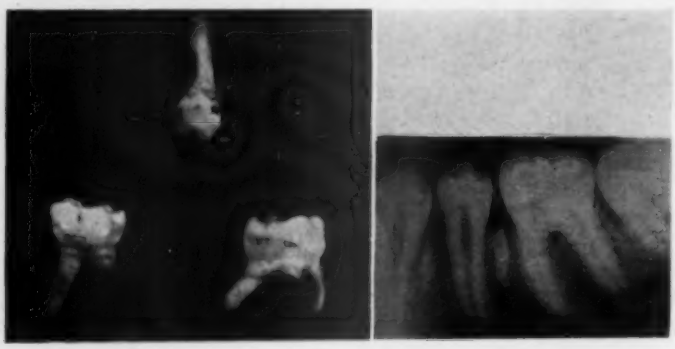
It is frequently necessary to expose unerupted teeth and to move them into the line of occlusion by orthodontic means, even if sufficient space is available for their eruption, when the unerupted tooth is past its physiologic eruption age.

Congenitally or traumatically malformed teeth should be studied from the standpoint of restoration before the decision is made concerning their preservation in the dental arch. Malformed teeth in the anterior part of the mouth on which jacket crowns cannot be constructed should be removed in the course of orthodontic treatment.[42]

CRITERIA FOR SPACE MAINTENANCE

In determining the need for space maintenance, the dental arches, the growth of the jaws, and their relation to esthetics must be given due consideration. Space maintenance thus becomes intimately related to orthodontic principles and is not merely a procedure to be practiced by the general dentist who may not have sufficient knowledge of dental development and arch growth.

Dentists have been repeatedly warned about the dangers of early or premature loss of deciduous teeth. Although not as widely publicized, it is well known that a sizeable percentage of malocclusions are attributable also to prolonged retention of deciduous teeth. While it is generally recognized that the presence or absence of the deciduous teeth is not a factor in jaw growth, it is an accepted fact that premature loss of deciduous teeth is a factor in malocclusion of the permanent dentition. The deciduous teeth reserve the vertical and horizontal space for the permanent teeth. Thus, they help to maintain the line of occlusion and the mesiodistal arrangement of the dental arch. The presence of the deciduous teeth prevents the exclusion from the line of occlusion of permanent succeeding teeth, especially premolars and canines.



A. *B.*

Fig. 16.—*A*, Uneven resorption of roots of deciduous teeth. *B*, residual roots of deciduous teeth in alveolar process, following incomplete extraction.

Note.—Roots may become cystic, exostotic, interfere with orthodontic tooth movement, and cause reflex pain.

There are two schools of thought with regard to procedure after premature loss of deciduous teeth: (a) those who immediately place a space maintainer and (b) those who believe that space maintainers are altogether unnecessary and that malocclusion following premature loss of deciduous teeth occurs only in those children who a priori show a lack of jaw growth and who would under any circumstances show a malocclusion when the permanent dentition is erupted.

Those who favor the use of space maintainers should recognize that a space maintainer is a passive and frequently an active orthodontic appliance. As such, a space maintainer when placed in the mouth of a child should receive inspection and adjustment at frequent intervals, and removal from the mouth when no longer needed, to avoid interference with the erupting permanent tooth. Prolonged use of a space maintainer which interferes with the adjustment in the occlusion of the teeth that normally takes place with the eruption of the premolars and permanent canines is productive of malocclusion.

Among the conditions in which space maintainers should not be placed are the following:

1. When there is no bone overlying the crown of the erupting permanent tooth and the development of the oncoming permanent tooth shows about one-third of its root already calcified.
2. When the space left by the prematurely lost deciduous tooth is definitely in excess of the mesiodistal dimension of the permanent successor as shown by actual measurement of the roentgenogram and where the space shows no sign of closing beyond that point.
3. When opening or retention of the space is contraindicated because of a generalized lack of growth of the jaws and where such space maintenance would further complicate existing malocclusion.
4. Where the permanent, succeeding tooth is absent and where space maintenance is not indicated to preserve general occlusion and arch relationship.

Space maintenance during the mixed dentition period which is recognized as the most critical stage in the dental development of the child, if not properly applied, can interfere with the proper time-scale of adjustment when the deciduous teeth are shed, thus affecting the eruption, arrangement, and occlusion of the teeth in the permanent dentition. Knowledge of the development of normal occlusion, of the time sequence in the development of the child's dentition, and ability to recognize the rate and direction of the general physical maturation of the child in relation to the development of the dental growth pattern are the primary requirements of preventive orthodontics. The foregoing applies with especial force to the placement of space maintainers.

ABUSE OF APPLIANCE THERAPY

From the orthodontic standpoint, the patient with a deciduous or mixed dentition, or even the one with a young, permanent dentition, presents a dentition in a dynamic state. Changes follow quickly, one upon the other. These changes may be of a favorable or unfavorable nature, whereas the sequence of change in the adult dentition, barring those effected by orthodontic procedure or by dental care, are practically always of a retrogressive nature.

Appliances inserted into the mouth at certain periods can be extremely harmful to the spontaneous tooth adjustments necessary for the establishment of normal occlusion. An example can be found when the maxillary permanent anterior teeth are completing their eruption and the maxillary central incisors are moving together while the maxillary lateral incisors are undergoing their final stages of eruption.

Another example is to be found in the insertion of appliances which bind the anterior and lateral segments of the dental arch and prevent the development of space at the deciduous canine to accommodate the wider permanent canine. Still a third locus of interference with the eruptive adjustment of the dentition is in the use of appliances which prevent the permanent first molars from achieving their forward adjustment subsequent to the loss of the deciduous molars and the beginning of the eruption of the premolars. Interference with the forward adjustment of the permanent first molars at this time results in loss of proximal contact in the region of the premolars. Such loss of contact

is usually followed by rotation and inclination of the premolars with disturbance of the entire occlusion. Thus, a new malocclusion of a generalized type may be initiated while attempting to correct a local malocclusion involving one or two teeth in a part of the arch.

Fig. 17.—Photograph of a boy aged 7 years, 6 months, showing joined cast bands placed by dentist to hold permanent maxillary incisors together while lingual occlusion of the mandibular molar teeth was permitted to remain uncorrected.

Orthodontic therapy, whether or not it involves the use of mechanical appliances, should be undertaken as soon as it is recognized that a condition exists which interferes with normal growth, development, function, or relationship of the teeth and dental arches and there is little possibility of correction by further growth or developmental processes alone. As far as the use of appliances in orthodontics is concerned, it should be remembered that there is generally greater danger in "too much, too soon" rather than in "too little, too late."

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TUBE SPRING AND "T" SLEEVE

ARTHUR THORNTON TAYLOR, D.D.Sc., SYDNEY, AUSTRALIA

FOR a very considerable time orthodontic therapy has been directed toward the solution of the problem of the crowded dental arch, and much controversy has centered around both the theoretical and the practical aspects of this phase of orthodontic treatment.

It may perhaps be accepted that the distal movement of the posterior tooth mass is still the desideratum in our technical endeavors, and the challenge here implied has been taken up by many skillful and earnest workers in our field. Angle, perhaps was the first to offer any considerable advance on earlier techniques, which for the main part gained arch dimension by general expansion, depending on the first permanent molars as the most stable anchorage available. With his later attempts at distal "mass" movement utilizing the tie bracket and edgewise arch mechanism, a great deal of ingenuity and technical effort was expended in the pursuit of posterior segmental movement.

This technique, tedious and difficult though it was, in the hands of many of the Angle group produced some very encouraging results, but it was not long before the methods of cephalometric appraisal and a more critical clinical approach led finally to the Tweed bombshell[1, 2] which showed conclusively that the tip-back technique was not the answer to the problem of full arch development.

It had before this time become evident to me that most orthodontists were having trouble with the technique of distal movement, for when in 1934 it was my privilege to visit many of the world's leading orthodontists, I particularly studied this problem and became more than ever convinced that the previously taught methods would have to be modified.[3]

One could not escape the conclusion that the highly skilled orthodontists of the later Angle group who came out so valiantly as champions of distal mass movement of teeth were finding difficulties in the clinical application of their beliefs, and they came eventually to conclude that they were forced into extraction (of premolars) in an increasing number of cases.

Their difficulties were very early apparent to me, for as one who emerged from the Angle school imbued with similar ideologies and ideals, I soon saw and experienced many of the pitfalls and difficulties in the way of distal mass movement and strove to find alternative ways of achieving this end.

In efforts to achieve backward movement, too much disturbance was being created in the dentition generally, largely because of conflicting force control, many of the forces used being opposed or neutralized within the mechanism itself. The basic principle of one plane of force application was being disastrously ignored, and with this in mind a new solution was sought.

Desiring essentially to build on what technical knowledge and ability I possessed and using basically the appliances and equipment of the Angle technique, certain conditions were postulated and attempted to be observed.

POSTULATES

There should be:

1. One plane of force.
2. Continuous and easy force application and adjustment.
3. No opposing forces—as far as possible the forces applied should be capable of easy resolution. There should be no torques or "brakes" to the desired movement.
4. A technique capable of being supplemented by or used in association with intermaxillary anchorage.

Several fundamental changes in one's conception of appliance mechanics became necessary. One needed:

1. Freely sliding arch engagement to reduce frictional conditions to the minimum.
2. "Positive force" capable of being held lightly yet firmly to the site of its application.
3. No significant changes in the location and direction of the stimuli to movement.
4. An appliance in its entirety capable of implementing simultaneously other necessary tooth and arch movements.

Before proceeding to a description of my technical developments, it must here be stressed that although the technical modification and new appliance construction herein described may possess some intrinsic merit, the conventional Angle tie bracket, rectangular molar tube, and round labial arches remain the basis of my mechanical therapy.

With this submission as the background of the technique, I shall endeavor to describe the technical developments offered as a means of gaining arch dimension and spatial development within the denture.

The problem is approached separately for the two dental arches. Largely by an evolutionary sort of development, a technique was first evolved for the lower dental arch. While at first concentrating on gaining dimension in the anterior part of the mouth, gradually with use and practice the appliance was applied over greater portions of the dental arches until it became of application anywhere from the cuspids to the molars. This apppliance has been named "the curved tube spring appliance"[4] by reason of the nature of its specific components.

In the upper dental arch, the auxiliary developed and later to be described became known as the "T" sleeve appliance.

CURVED TUBE SPRING APPLIANCE

The application of the curved tube spring appliance (Fig. 1) came to serve both as an active independent appliance, useful in early treatment in the deciduous and mixed dentitions, and one capable of adaptation to the basic Angle

technique, or it could be used with any other technique incorporating bracket engaged labial arches. In this instance while using tie brackets, angular arches were discarded in favor of round arches for force application.

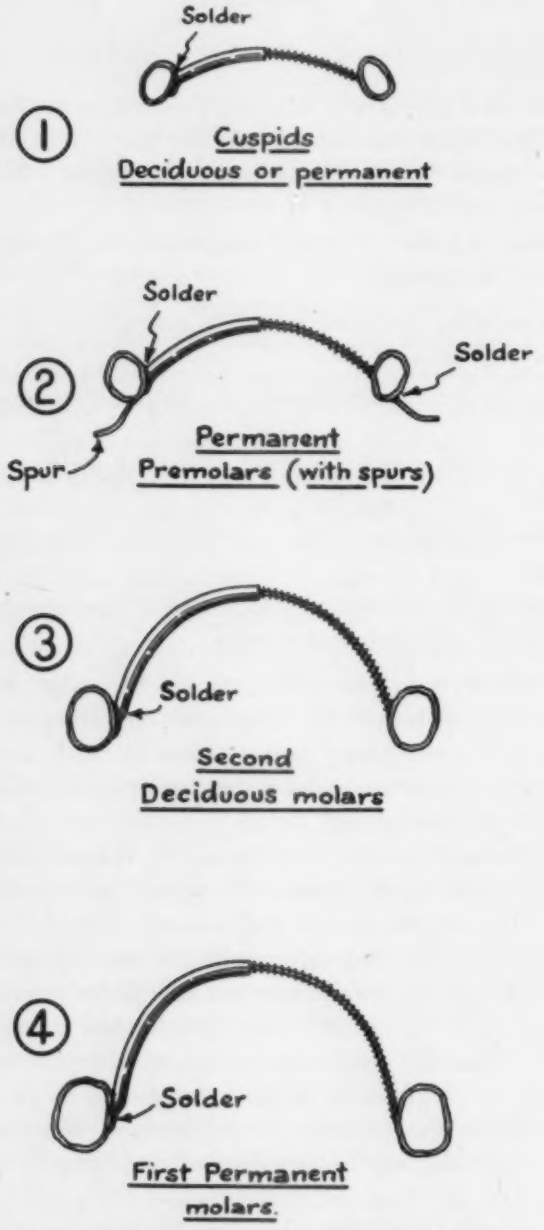


Fig. 1.—Four examples of curved tube spring appliance illustrating adaptability to various curves and dental arch locations.

The tube spring, by its particular properties and method of application, also offered a significantly better anchorage for reciprocal movements in the upper arch, particularly in Class II malocclusion, where a "relatively" station-

ary mandibular anchorage for the distal movement of maxillary teeth is necessary. The word "relatively" is used advisedly in the knowledge that a perfectly stationary anchorage is impossible of attainment within the denture.

It is not easy to put into mere words the many ways in which this "auxiliary" may be used for movement or anchorage; suffice it to say that it is most general in its usefulness and may be applied when the usual banding techniques used with labial arches cannot be efficiently utilized. Such conditions occur in incomplete eruption or premolars with a deep and close incisal overbite, when it is desired to commence some treatment within limits of safety and with a reasonable degree of efficiency. However, it is not intended to stress this sphere of usefulness; one may remain content to urge its use in a wider and more varied sense where heretofore the conventional Angle banding technique might have been chosen.

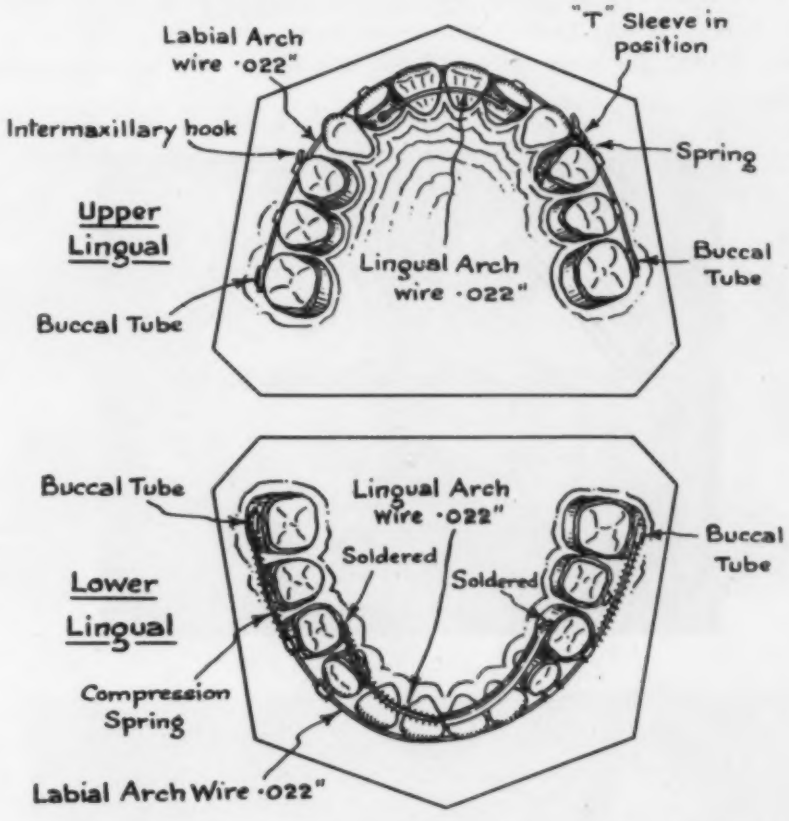


Fig. 2.—Expanded view. Use of labial and lingual arches fixed and mobile.

A typical case wherein this technique has been utilized is illustrated by photographs and technical diagrams (Fig. 2). This patient, a girl aged 12 years, living some 400 miles away, posed a problem in treatment requiring suitable appliance construction capable of gainful movement with the least number of adjustments because of the distance she was from me. Both upper and lower dental arches were constricted, the upper cuspids and the lower second pre-

molars, particularly being blocked from the arches. Treatment required general arch extension and backward movement of the upper and lower posterior tooth mass.

Bands were placed in the upper dental arch on lateral incisors, first premolars, and molars, while on the lower arch a tube spring was placed on the first premolars only. One month later, the lower molars were banded and a labial arch placed allowing control of the dimension between the first premolars and molars by the use of spiral spring engagement. Adjustments were made from time to time of both tube spring component and the labial appliance, and while dimension was being gained a suitable anchorage was available for intermaxillary movement incorporating distal movement of the upper posterior teeth.

This distal movement was achieved by the utilization of a "T" sleeve appliance, later to be described, and the necessary dimension in both dental arches was gained in eight appointments between May, 1946 (Fig. 3, *A*), and March, 1947 (Fig. 3, *B*). As the patient was so far away, one was dependent upon this child's local dentist for supervision of the appliance, but no adjustments were made by him.

A. *B.*

Fig. 3.

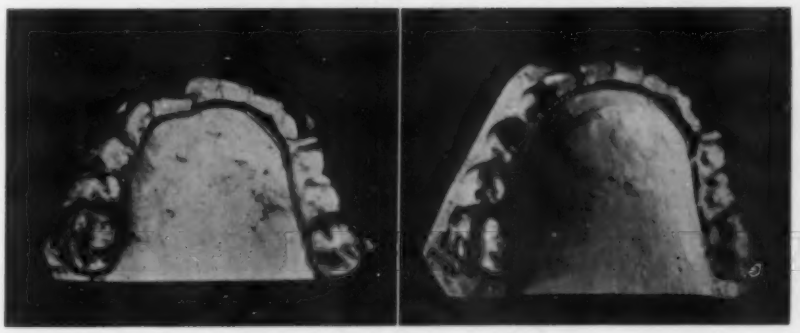
Fig. 2 shows details of the technique used and drawings of the actual appliances, the upper appliance being photographed in situ (Fig. 4) and full face and profile (Fig. 5), which give some indication of the patient's facial balance with no evidence of prognathism or "toothy" appearance.

It is noteworthy that in the use of this auxiliary a labial arch technique can be incorporated at any stage. The tube spring is commonly used to institute movements, and as development is gained labial banding is taken up for individual tooth movements; or, conversely, an active labial segment may first be utilized and then a lingual technique may be added for additional anchorage; say a tube spring at first for further arch extension which later may be converted to a fixed anchorage for retention.

Fig. 6 illustrates the use of the tube spring as an active appliance. Note the step-bend on the left lateral in *A* which was gradually brought to a smooth curve while arch dimension was gained. The overexpansion shown in *B* is noteworthy. This case is presented merely to illustrate the possibilities of the appliance in that desirable regard.

Fig. 4.

Fig. 5.



A. *B.*

Fig. 6.

TECHNICAL DESCRIPTION

COMPONENTS (Fig. 7).—

The Female Component.—Platinous gold tube, 0.026″ lumen with 0.006 walls.

The Male Component.—0.022 platinous gold arch wire.

The Activating Component.—A stainless steel spiral or coil spring.

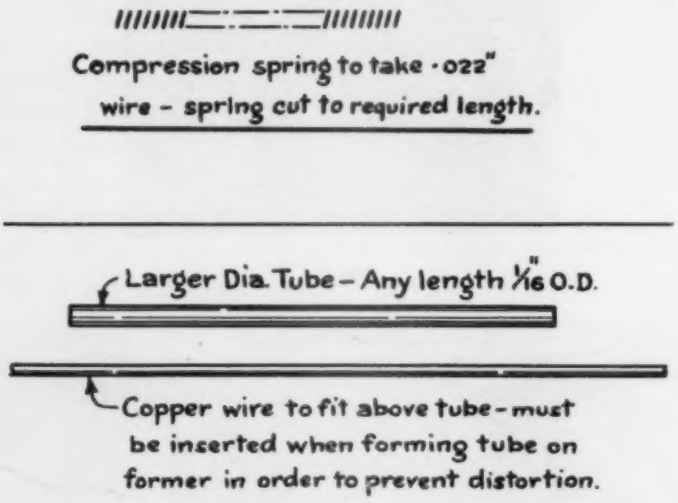

Compression spring to take ·022"
wire - spring cut to required length.
Larger Dia. Tube - Any length 1/16" O.D.
Copper wire to fit above tube - must
be inserted when forming tube on
former in order to prevent distortion.

Fig. 7.—Curved tube spring appliance.

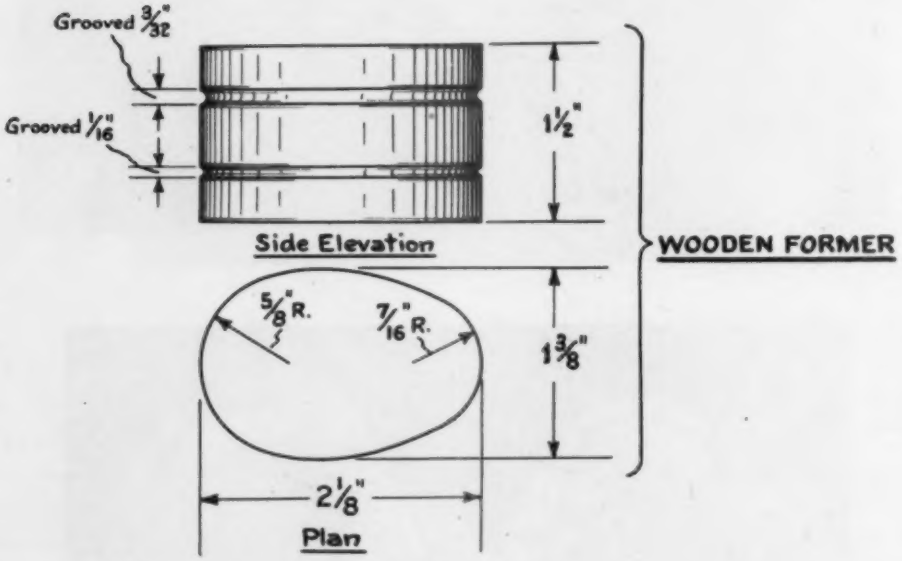


Fig. 8.

This spiral spring has been standardized to be used generally with this technique, either labially or lingually. It is wound on 0.022 wire to slide easily on it, and the tubes are of such a size as to embrace also for free sliding the arch wire and spiral spring assembly.

A mandrel or wooden spool (Fig. 8), elliptical in shape and grooved circumferentially so that any desired curve may be obtained by bending the tube over it.

A snugly fitting copper wire must be inserted in the tube during bending operations to prevent buckling or crimping.

TECHNIQUE OF APPLIANCE CONSTRUCTION

1. Fit anchor bands, solder, and replace on teeth.

2. Take a plaster impression with bands in place and wax the inside of the bands lightly.

3. Pour model.

4. Remove the impression, melt wax off bands, and replace on model.

5. Examine arch contours to select side for placement of the curved tube and spur respectively, the smoother curve for the tube side, the more irregular curve for the spur, which could be more easily contoured around, say a lingually placed lateral (Fig. 6, *A*). As this bend is straightened to a smooth curve at respective adjustments, the desired labial stimulus is gained to move the lingually placed tooth or teeth.

6. An appropriate length of 0.022 platinous gold wire is soldered to the molar tube of the side selected—the male component.

7. The free end of this wire is curved snugly around the lingual surfaces of the teeth until it meets the cuspid of the opposite side (in a molar to molar appliance); in general two-thirds of the distance circumferentially between the anchor bands.

8. A length of chaneer (tube) is then, with copper core inserted, bent around the wooden forming "mandrel" in such a manner as to allow a smooth curve of the tube to be adapted lingually so as to overlap or encompass the male portion to an appropriate length, depending on the over-all length of the appliance. The criterion of this length is in all cases that the male component with spiral spring fitted over it shall remain within the female component, but not so far that it will bind.

9. This female component is then set (without the activating component) passively over the male component on the model in close contact on its distal end with the molar band and soldered to it.

Note: This is never done freehand, but soldered on the model for accuracy.

10. The appliance must have *resiliency* when the activating component, the spiral spring, is adjusted so as to give the desired amount of stimulus for arch expansion. The two components are then ready to be joined together, with the activating component so placed as to create an oversize of approximately one-eighth inch in the appliance, which is then cemented in place.

11. Adjustments are made at intervals of three to six weeks when the anchor bands are removed and the activating components lengthened one-eighth inch approximately, and any bends of the male component are eased into an increasingly smooth curve. The appliance is recemented for a further three to six weeks according to requirements. Fig. 1 shows some of the variously disposed curvatures available with this appliance.

SAFEGUARDS OR THINGS TO WATCH

1. Breakages.—It has been my experience that the appliance, by virtue of the size and strength of the curved tube, is more subject to breakage than the conventional appliance where many teeth are banded and attached to a labial arch. However, with reasonable care these appliances remain undamaged for months at a time and cases can be reported where the appliances have been removed and adjusted only twice in six months.

Careless chewing of too big pieces of food and the other usual hazards have invariably been found responsible for breakage, which is usually confined to either the anchor bands or the lighter arch of the male component.

2. Anchor Band Rotation.—There is some tendency for eversion of the anchor bands with this appliance, but it mainly applies to molars, either deciduous or permanent, and is not a hazard with cuspid or premolar anchorage.

This movement can happen where the curve of the respective components is too marked and excessive adjustments are made—too great spiral spring compression resulting in an outward movement of the tube and spur, which outward movement is translated distally to the anchor bands, whose mesiobuccal corners tend to move outward. This tendency can be checked by adjusting the curve of the tube and seeing that the appliance does not remain too long without inspection.

3. Compression of the Soft Tissues.—This occurs but rarely, but in some younger children in the mixed dentition it is a hazard that must be watched, more particularly on the side of the tube.

DISTAL MOVEMENT IN THE UPPER DENTAL ARCH

With an appreciation of the ease, in most cases, with which arch dimension was gained with the curved tube spring appliance, and the great reduction in operating time and frequency of visits necessary to accomplish the movements under review, one's attention turned to the vexed question of maxillary cuspid space, the loss of which has been diagnostically associated with the forward movement or "drifting" of the posterior teeth mass, i.e., the premolars and molars of the permanent dentition.

Unlike its forerunner the tube spring appliance, this newer auxiliary has so far only been applied in those cases where at least the first and second premolars and first molar are in place in the dental arch, the cuspid space having been reduced or eliminated entirely—the type of case that so often has been sentenced to premolar extraction as the solution to the problem.

Supported by clinical experience, I have long held to the accepted generalization that a restricted maxillary arch, particularly with anterior tooth crowding or with regularly placed incisors and diminished cuspid space, is associated with three essential factors:

1. Forward drifting of posterior teeth.
2. A greater or lesser degree of lack of forward development of the incisor segment.
3. A narrowing of the dental arch in the premolar area.

These three symptoms of malocclusion may occur separately or in combination, and it remains for one's diagnostic perception to unravel the malocclusion and treat it in terms of one's technical capacity.

As indicated in the introductory portion of this article, the attempt was made to evolve an appliance that would permit distal movement without departing from the principle of one plane of force application, and to this end components were evolved for utilization with the conventional labial arch, retaining the bracket engagement of the tie bracket and edgewise arch technique, but using in all instances light round instead of rectangular arches.

THE "T" SLEEVE APPLIANCE

Components.—Resolved into simplest terms, the "T" sleeve auxiliary consists of one-eight inch length of platinous gold tube with 0.006 inch walls with lumen 0.023 inch approximately (to engage and slide easily on a 0.022 round arch wire); to this sleeve or tube there is soldered at right angles a short (three-fourths inch approximately) length of 0.022 platinous gold wire. (Fig. 9.)

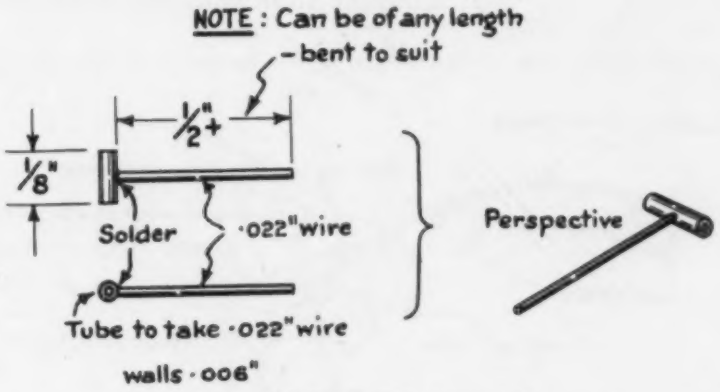


Fig. 9.—Details of "T" sleeve unit.

Another one-eighth inch tube is soldered on the lingual aspects of the first premolar band on the mesial side of the lingual seam and parallel to the margins of the band (Fig. 10.).

After sliding the "T" sleeve on the labial arch, which itself is engaged snugly with its appropriate brackets, the free end of the "T" is bent distally so as to engage without tension the lingual tube and project 1 mm. approximately from its distal end (Fig. 10): too much projection creates a point of wire uncomfortable to the tongue.

With the "T" sleeve now seated, a length of spiral spring wound to an easy fit over the 0.022 axis (this is standard) is cut to a length necessitating very little compression at its site of engagement when the brackets are ligated respectively on lateral and premolar bands, and the labial arch adjustment completed (Fig. 11).

The patient can then be dismissed for two or three weeks, and at the next visit the spiral spring can be disengaged, lengthened one-eighth inch, and retied.

This simple adjustment is continued until the necessary cuspid space has been gained.

The six steps of "T" sleeve construction and adjustment are set out serially in Fig. 12.

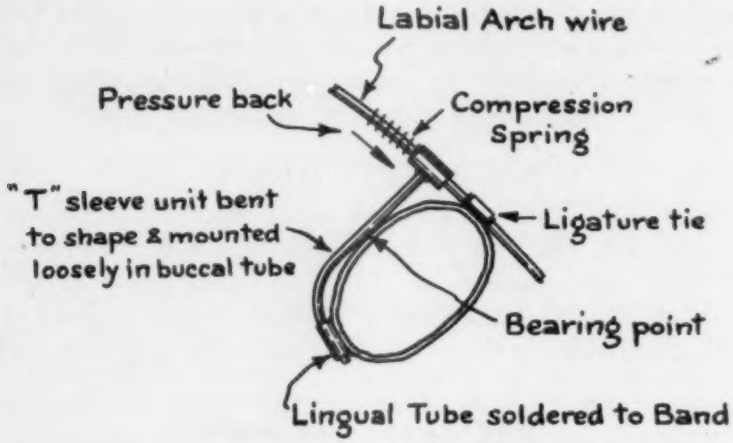

Labial Arch wire
Pressure back
Compression Spring
"T" sleeve unit bent to shape & mounted loosely in buccal tube
Ligature tie
Bearing point
Lingual Tube soldered to Band

Fig. 10.—Enlarged view of premolar band showing action of "T" sleeve unit.

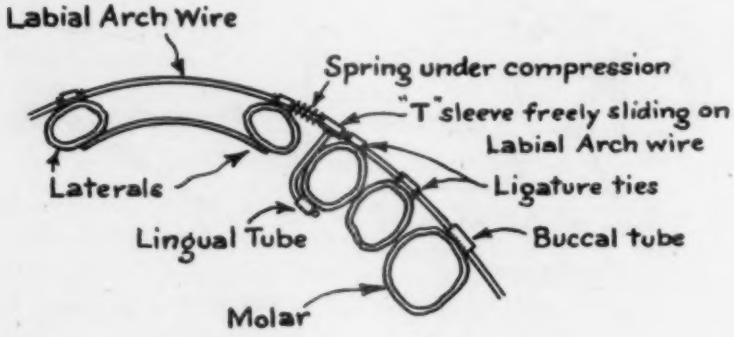


Fig. 11.—Plan view of units assembled.

Dealing With the Reaction to This Force.—It will be immediately contended that the forward stimulus of the compressed spring spiral, being equal at both ends, will result in some forward movement of the anterior teeth which are attached to the labial arch, and that a forward movement or stimulus exists will not be denied. However, certain steps are necessary to counteract this tendency:

1. Maximum anchorage of the central and lateral incisors. Either band central and lateral incisors if out of line, or, better still, if in line, band only lateral incisors and join them lingually by soldering a wire between the lateral bands. This gives the best available stationary anchorage to this segment.

2. Oppose any movement of this anterior segment away from the spiral spring by a spiral spring between the lateral incisors and premolar of the other side, even if space in this area is sufficient. Thus, the whole of the rest of the arch remote from the segment to be moved opposes the reactionary or opposite thrust.

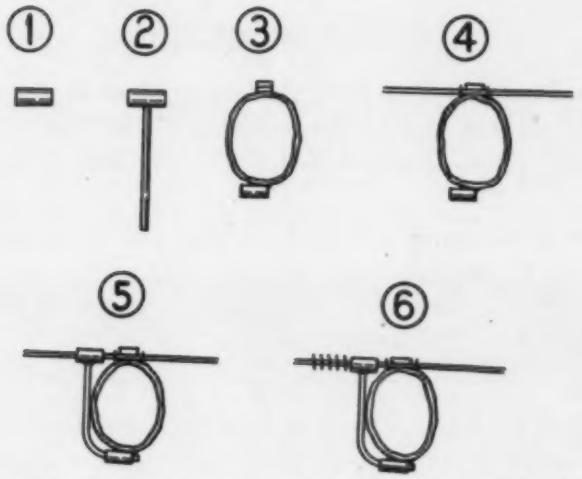


Fig. 12.—Six steps of "T" sleeve construction and adjustment.

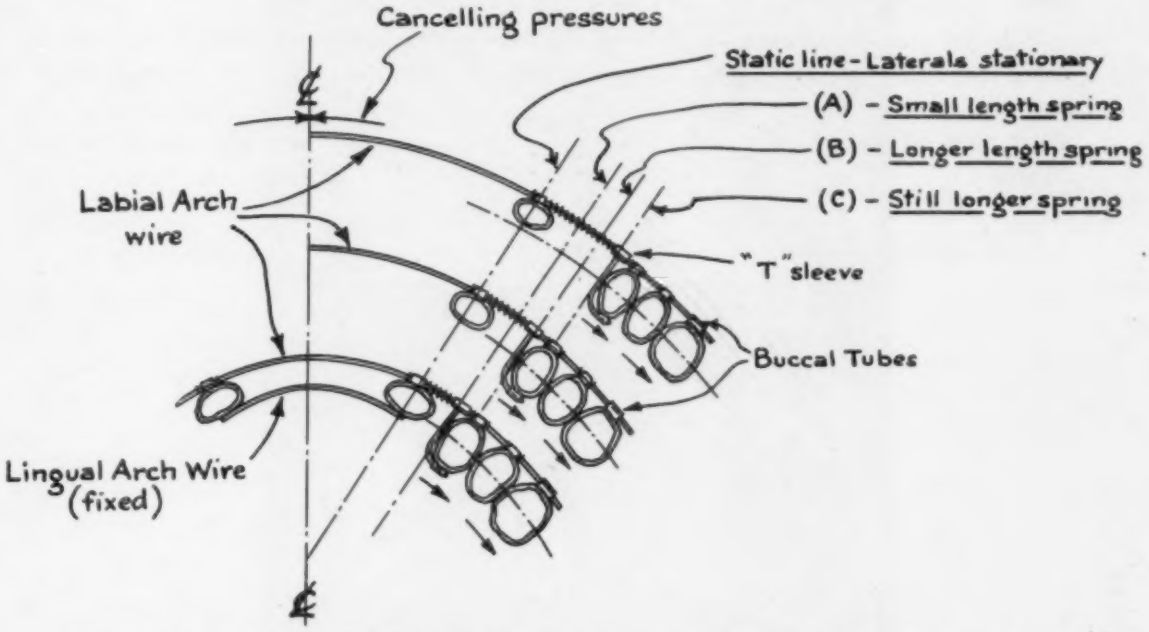


Fig. 13.—Diagrammatic presentation showing pressures in three stages on molars by "T" sleeve springs of increasing length. Note direct back thrust on molars—no turning moment.

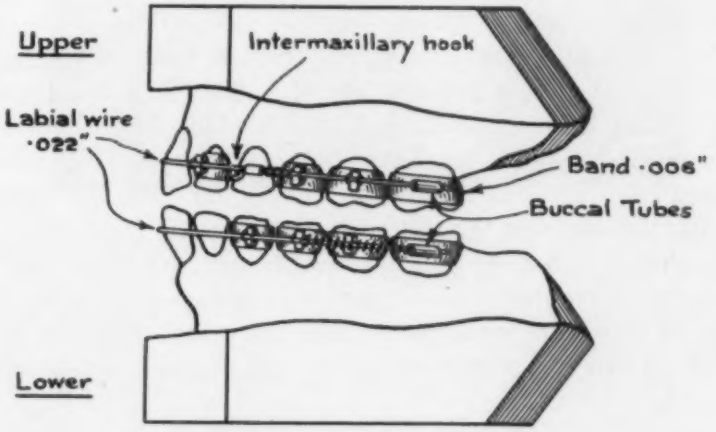


Fig. 14.—Left elevation. Use of labial arches.

3. Furthermore, the spiral spring being applied in the arc of a curve is neutralized in the medium line by the opposing thrust, even though this be very light, of the spiral spring engaged distally to the lateral on the opposite side (Fig. 13).

4. This neutralization in the medium line can be helped very positively by the utilization of intermaxillary anchorage to which the "T" sleeve lends itself most admirably (Fig. 14). A rubber ligature can be looped over the labial arch and the mesial section of the "T" sleeve with the free end engaged over the mandibular labial arch in the usual Class II anchorage.

A positive backward pull is immediately available to augment the backward thrust of the spiral spring engaged at the site of movement. An additional advantage of the looped rubber is that it need never be out of the mouth; at mealtimes it can be slipped from the mandibular arch and left free.

A tabulation of ten typical cases where varying degrees of cuspid space loss ranging from partial to complete impaction shows that an average of five and one-half visits occupying twenty minutes each was all the time involvement that this technique required for this previously difficult movement (Table I).

TABLE I. TABULATION OF TEN CASES

	VISITS	DURATION (MINUTES)	
J. C.	6	15	
B. W.	7	15	(Fig. 16)
B. K.	7	30	
P. C.	4	15	
J. E.	4	10	
B. S.	6	30	
B. B.	8	15	
M. A.	3	30	(Fig. 17)
K. McK.	5	15	
A. J.	4	15	(Fig. 18)
	54	190	
	5.4	19	
Say	5½	20	

It must be pointed out that this was not the full time of treatment for the complete malocclusion, but the dissection is presented merely to illustrate the efficiency of this auxiliary.

Fig. 15 illustrates the dimension gained by labial arch extension and a "T" sleeve auxiliary on the left first premolar only. This child lived over 400 miles away. The appliance was placed on June 18, 1946; four appointments were utilized between then and October, when the appliances were removed in an impression and transferred to the model (Fig. 15, *B*). Fig. 16 shows the initial condition with the left first premolar in contact with the lateral incisor, the upper right central incisor in this instance being devitalized and carrying a porcelain crown. The anterior anchorage was augmented by soldering a lingual bar from lateral incisor to lateral incisor and the cuspid space was gained, using a "T" sleeve, in seven appointments occupying fifteen minutes each. Fig. 17

illustrates another case of severe loss of cuspid space in this instance associated with extraction of the first permanent molars, necessitated for clinical reasons before orthodontic treatment was undertaken. Fig. 18 illustrates a segment of the arch wherein the cuspid space was gained in four visits of fifteen minutes each.

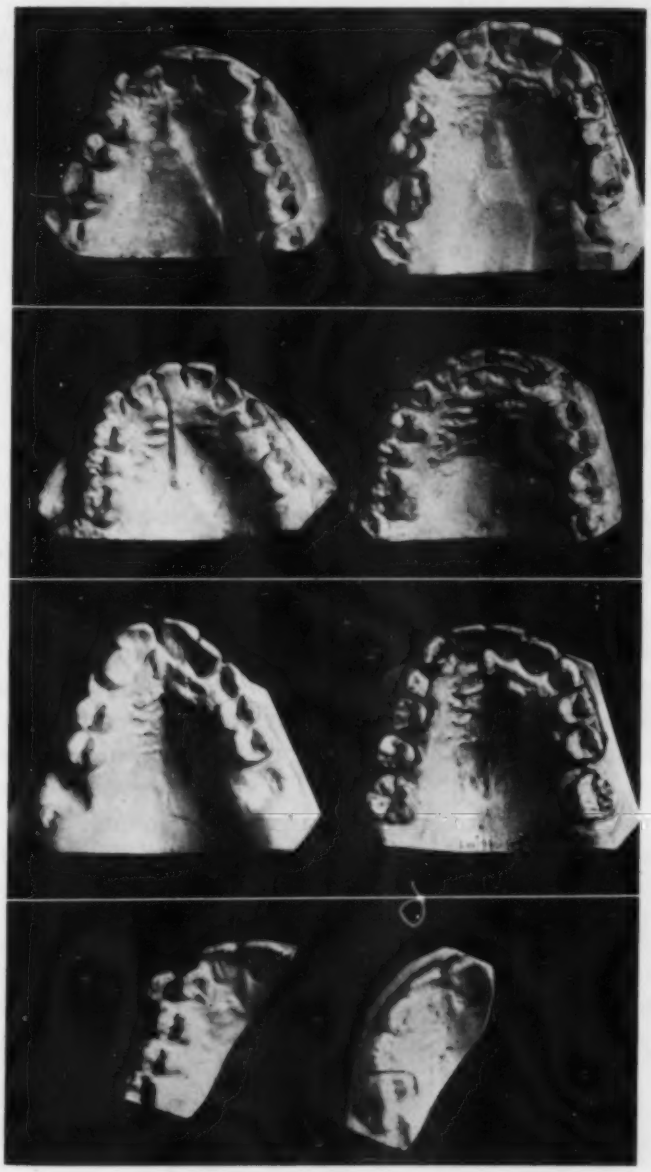


Fig. 15.

Fig. 16.

Fig. 17.

Fig. 18.

It is desired to point out in these few examples that the distal movement of the premolars was gained without rotation of these teeth, the teeth themselves tending in all instances to pivot around their apices and move distally along the labial arch in a sliding torqueless movement without rotation. The mechanics of the "T" sleeve auxiliary are diagrammatically shown in Fig. 13 wherein the

anterior anchorage remains stationary, or relatively so, while the activating force of the spiral springs, by periodic adjustment, is expended in a backward or distal movement of the premolars and molars.

Reference may perhaps again be made to Figs. 2 and 14 which illustrate the two auxiliaries here described, working in combination with conventional Angle tie brackets and arch engagement. Never previously has the writer been able to achieve this type of bimaxillary movement with so little adjustment. On removal of the appliances, Dr. J. S. Baird of Sydney kindly examined this patient's mouth and he testified to the stability of the teeth and the general health of the soft tissues. The models shown in Fig. 3, *B* were taken seven months after the removal of the active appliances, an upper removable plate retainer being at that time worn.

CLINICAL FINDINGS

1. Very few appointments necessary.
2. Adjustment is simple and not time-consuming.
3. No untoward reaction has been observed.
4. The occlusal plane is not disturbed to any great extent.
5. No recorded gingival recession.
6. No recorded apical absorption.
7. Other tooth and arch movements can be carried on at the same time; arch expansion can be gained without interference with the work of the "T" sleeve in its backward movements.
8. While overtreatment (too much space) is desirable, the bands can be removed as soon as the necessary space has been gained and a "Z" spring can be incorporated in the retainer to maintain a backward thrust on the first premolar if thought necessary. There is always a tendency to lose the space that is so quickly gained before the cuspid erupts fully, as this development is sometimes very slow.
9. There is no waiting for axial inclinations to normalize as in the case when second order bends of the Angle technique are utilized: this is most important.

The writer does not pretend that these technical auxiliaries may usher in a new era of orthodontic therapy. He will be content if they show another way of treating some of our more tedious orthodontic problems. Further clinical data will later be offered in support of this paper.

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ORTHODONTICS IN RETROSPECT*

JOHN V. MERSHON, D.D.S., PHILADELPHIA, PA.

TWENTY years in the general practice of dentistry plus forty years in the exclusive practice of orthodontics provide an excellent vantage point from which to view developments in the field of orthodontic therapy. The perspective gained through years of observation gives one an opportunity to evaluate trends and patterns in the light of what has gone before.

When I entered orthodontics in 1908, I was one of a half-dozen orthodontists in an area of one hundred miles in and around Philadelphia. Today there are probably a half a hundred in the same area. The increase in the quantity of orthodontic service is similar in all parts of the country. But what of the quality of orthodontics? If marked on a graph covering the last forty years, it would not show a gradual, steady rise, but the jagged, up-and-down pattern of a weather chart or industrial report of the state of business.

When I attended the Angle School in St. Louis, the course stressed above everything else in the curriculum the importance of every tooth. For a general dentist to allow a patient to lose a tooth through his neglect was looked upon as a crime. For an orthodontist to extract a tooth as part of his therapy was condemned in definite and unqualified terms. We were given a thorough instruction in the oral tissues, their structure, and function.

If one has a correct understanding of the gingival tissues, the periodontal membrane, the alveolar process, and everything which goes to make up the tissues of the oral cavity, he will realize that it is better to leave teeth in slightly irregular positions rather than extract any teeth. The removal of one tooth destroys the harmony of tissues because there is an interrelation of tissues even though the teeth be somewhat irregular.

The appliances used when I first entered orthodontic practice, while primitive in a sense, were so designed that they would not do harm to the oral tissues if properly used. I soon found them too cumbersome for my taste and, accordingly, developed the removable lingual arch. With this mechanism I was able to effect results more easily, more safely, and with less inconvenience to the patient.

Shortly after I originated the idea of pressure as light as one can use it with 0.020 auxiliary springs used intermittently, Dr. Oppenheim undertook to test the truth of my contention through laboratory methods. He was good enough to publish his scientific findings in support of my clinical observations.

But appliances are the smallest part of our current problem. I condemn certain types because I feel they injure the teeth and oral tissues. Other types seem injurious because they limit the normal development and growth of the organism.

*In an effort to focus orthodontic thinking, the Editor of the AMERICAN JOURNAL OF ORTHODONTICS has asked several individuals of wide and mature experience in the orthodontic field to express their views on the past and present as to orthodontic progress. Dr. Mershon's views are the first of these to be published, and it is to be hoped that others expressed by those of wide experience may be published in the not too distant future.—*Editor.*

The reason I have always opposed any type of appliance in which multiple bands are used is because I have felt that inasmuch as we are treating growth, it is essential that nothing interfere with the normal growth forces, and multiple bands do interfere with normal growth.

The human face, its osseous structure, and teeth move in many directions in the course of development. There is a change taking place in all the oral tissues until the mid-twenties; the ramus is increasing in length, the mandible is growing longer; the lower teeth are erupting upward and the upper teeth downward; the maxilla is having a corresponding growth change. The face is growing in all directions as a result of these developmental changes. At this time there is being established a closed bite, a deep overbite, or the bite may be opening as it often does between the ages of 14 and 20.

With all of these complex changes taking place, is it any wonder teeth moved in a comparatively short time, as many men are now trying to do, seek their own positions after appliances and so-called retainers are removed? If extraction has been resorted to, the teeth have no normal position to seek.

I do not feel that the removable lingual arch, as I used it, is the only good appliance. Others may serve equally well. It all depends upon how they are used and the philosophy behind their use.

The fact that I have treated thousands of cases satisfactorily during the last forty years without any substantial change in my philosophy or methods of practice makes me wonder what lack of knowledge or misconception is behind the current hectic orthodontic situation. Many orthodontic meetings today seem just a shade removed from a Hatfield-McCoy feud. Too many men seem more eager to defend their positions than to seek the truth.

My following the same method for many years is not the result of isolating myself in an ivory tower and assuring myself that I had the only correct answer to the orthodontic problem. I have read widely and have discussed the problem freely with those who have disagreed with me. I feel, with a few exceptions, orthodontists are sincerely trying to render good service. Their faults lie in ignorance and impatience.

No one who has been well educated can help knowing that growth cannot occur when it is restricted by any inhibiting device. Many of our schools are not giving their students a thorough groundwork in the nature and pattern of human growth. It is an undisputed fact that development of the dental arches is not only forward and lateral but downward as well. Can this normal growth take place if the teeth are rigidly held in fixed positions during the developmental period? No one can be so foolish as to believe that once appliances are placed they are the sole directors of growth. I have said before but I think it bears repeating: "Put any sort of appliance on a skull and nothing happens." Surely, that is conclusive proof that it is the organism which produces the change; we merely stimulate and guide growth changes. No set of teeth ever remains exactly where it is when orthodontic treatment is terminated. The human organism is constantly changing. The teeth are not a fixed mechanism but a part of this ever-changing human organism.

We are, more than any other dental specialty, a part of medicine, the healing art. We have seen all manner of trends in this profession. For years there was little therapy beyond the physical (heat, cold, rest, exercise) and chemical (the drugs). Then the biologicals held sway. They in turn have given way to a whole new series of drugs, some chemical, some biological. But through all these changes, medical thinkers have always known that the only real cure lay in the organism. The most that any drug or therapy can do is to help the body fight its way back to health. It is the power inherent in the organism which brings survival and recovery or death. Two people with the same condition, treated in the same way, do not respond identically; their individual characteristics determine the outcome. So it is with orthodontics. There is only one safe dose. We cannot overtreat one patient because we are in a hurry or because he seems slow in responding to treatment.

It is this impatience, coupled with ignorance, which lies back of extraction practices. To extract teeth at 10 or 12, when we cannot possibly know the extent to which the organism will develop at maturity, seems as sensible as for a physician to amputate a leg because it is shorter than the other.

I have always refused to give more than a qualified opinion when shown a set of models of a mouth. They show nothing but the teeth, and that is only a small part of the orthodontic problem. We must see the whole patient for two reasons. First, his general appearance and behavior indicate a gretat deal as to his physical stamina and development. Second, his type of face will indicate what we may safely set as our goal. Certain chins will always remain receding, whether or not the teeth are made to occlude ideally. The reverse is true. Certain chins will remain prominent even after a Class III case is corrected. If certain teeth are congenitally missing or have been lost, we may have to compensate by allowing a mesial or distal occlusion to remain on one side.

The impatience to which I have referred applies not only to haste in proceeding and in trying to finish cases quickly, but to an extreme desire to produce an ideal mouth. Some men strive to have every tooth aligned according to an exactly preconceived pattern. They forget that no human being is perfectly symmetrical. And in their mistaken idealism, they strive so hard to make the mouth and teeth exactly regular that they forget the mouth and teeth are parts of a whole. If men had an opportunity to see all of their former patients at the age of 25, many of them might change their ideas about extraction. I have seen so many faces in which the teeth were evenly spaced but in which the underdevelopment of the face below the nose was so apparent as to seem a deformity. That is what extraction produces. So many men cannot see the forest for the trees. They are so concerned with the teeth that they forget the rest of the individual.

Our goal should be to help the organism to reach its fullest development but according to its own inherent pattern of development. We should think of ourselves as guides rather than directors. I have started some cases which I thought could never come out right without orthodontic intervention. By going slowly and watching carefully, many of them have come to an ideal development with appliances in place for only a few months although the cases

were watched for many years. These, of course, are exceptions, but they serve to show how determined we must always be to give nature every chance before we intervene. And when we must intervene, let us still give all the freedom possible to the oral structures. If results can be achieved without extraction and rigidly fixed appliances, why resort to such potentially dangerous methods?

My treatment, including observation, covers a long period of time, but the appliances are actually in the mouth a shorter time than with the multiple band rapid treatment method. Surely it is better for an adolescent to be under treatment and observation during his teens and arrive at maturity with a sound, unmutilated mouth than to have ao carry the damage caused by extraction and rapid treatment the rest of his life. The old expression "haste makes waste" is never truer than when applied to orthodontic treatment.

1520 Spruce Street.

SUGGESTED PRINCIPLES FOR PUBLIC ORTHODONTIC PROGRAMS FOR CHILDREN

JOHN T. FULTON, D.D.S.,* WASHINGTON, D. C.

ORTHODONTICS has much to contribute to the proper growth and development of children. Yet, seldom is this science included in programs of dental health services. Since dental health is an essential part of child health, it is hard to justify the omission of orthodontics. One explanation might be the surprising lack of information on the actual size of the malocclusion problem, and the need for accepted standards and methods of procedure.

The Children's Bureau, through its duty to ". . . investigate and report upon all matters pertaining to the welfare of children and child life" (the Congressional Act creating the Children's Bureau, approved April 9, 1912), serves as a center for the development of principles and standards of child care. In this work, the Bureau enlists the aid of authorities in the field under study.

To consider the possibilities of stimulating more interest in orthodontics, the Children's Bureau arranged a conference of orthodontic consultants.† As an outgrowth of this conference, tentative principles for public orthodontic programs for children were drawn up. These principles include:

I. All orthodontic programs should provide:
   A. Education in prevention and interception of malocclusions.
      1. Training in these lines for general dentists.
      2. Emphasis on training of undergraduate dental students in basic orthodontic principles as they pertain to every phase of dental practice.
      3. For others interested in child health and welfare.
   B. Immediate service programs.
      1. Priority given to severe dentofacial deformities.
      2. Treatment provided for clear-cut interferences, cross-bite, and habits where such situations misdirect growth.

II. Good studies are needed to define the scope of the problem of dentofacial deformities.
   A. Surveys by competent orthodontists who can detect impending conditions of malocclusion.
      1. Surveys should be based on standard classification of malocclusion designed for survey purposes which has been tested for validity.
      2. Standardized methods of procedure should be used.
   B. Pilot programs. At least one service program designed to determine the most effective method of dealing with dentofacial deformities.
      1. To establish procedures for orthodontics on a public health basis.
      2. A tangible operation that would serve as a source of data for analysis.

*Dental Services Adviser, Federal Security Agency, Social Security Administration, Children's Bureau.

†B. Holly Broadbent, H. K. Cooper, L. B. Higley, Earl G. Jones, George R. Moore, J. A. Salzmann, Henry Klein, and John Knutson. In addition, the following men were invited but could not attend: O. A. Oliver, B. G. deVries, A. O. Gruebbel, G. M. Anderson, O. W. Brandhorst, and R. H. Strang.

III. Advisory committees.
  A. State public health programs should have an orthodontic advisory committee, preferably nominated by the state or district orthodontic society. This committee should recommend:
    1. Qualifications of orthodontists who work in the treatment program.
    2. Priority of cases for treatment.
    3. Standards for insuring quality of care.

IV. Dentofacial deformities must be regarded as crippling conditions and should be included in all public grants-in-aid programs designed to benefit the crippled child.
  A. Severe deformities which should receive priority include:
    1. Cleft palate and cleft lip.
    2. Ankylosis of the temporomandibular articulation.
    3. Malocclusions resulting from severe structural deformities involving growth of the jaws.
    4. Severe malocclusions resulting from diseases or trauma of the jaws.
    5. Malocclusions associated with defects which present a serious obstacle to normal development, education, and employment.

V. Minimum health standards of orthodontic services for children should include the following:
  A. Antenatal through 2 years:
    1. Surgical treatment for the cleft lip by a competent surgeon. If the infant is gaining weight and in good health, the optimum period for this surgery often is two to four weeks when a complete cleft of the palate is associated.
    2. Surgical treatment for the cleft palate if indicated by a competent surgeon after consultation with orthodontist and speech specialist.
    3. Treatment of accidents sustained by the teeth.
    4. Treatment of mouth infections.
    5. Application of preventive measures for the control of dental health other than those which are operative in nature including dietary, endocrine, allergy, and other involvements.
    6. Habit prevention and control.
    7. Education for the parent and dentist, on prevention of dentofacial deformities.
  B. Period of the primary dentition (3-5 years) (for the average child patient):
    1. Cross-bite in any region and/or malposition of the mandible, when it interferes with facial symmetry or tends to distort the growing facial structures.
      a. Lingually locked incisors to be treated at 3 to 4 years of age.
      b. Unilateral cross-bite to be treated at ages 3 through 7 if lower jaw is deflected and facial symmetry disturbed, realizing that the effectiveness of the treatment of deciduous teeth is questionable at 8 years or over. (*Note:* Ages 6 to 8 years are included in the mixed dentition period.)

2. Complete in-locking of molars.
   a. Maxillary arch within the mandibular arch.
      1. Bilateral.
      2. Unilateral.
   b. Mandibular arch within maxillary arch.
      1. Bilateral.
      2. Unilateral.
3. Premature loss of second primary molar before eruption of the first permanent molar.
4. Premature loss of other primary teeth.
5. "Submerged" molar.
6. Cases of congenital absence of teeth or presence of supernumerary teeth.
7. Habit-breaking recommendations.

C. Period of mixed dentition (6 to 12 years) (for the average child patient):
1. Prevention and removal of interferences to permit innate growth tendencies to be expressed.
2. Premature loss of primary teeth.
3. "Submerged" primary molar if space closure has begun.
4. Premature loss of permanent teeth.
5. Too long retention of primary teeth.
6. Cases of congenital absence of teeth, or presence of supernumerary teeth.

D. Period of permanent dentition (13-17 years) (for the average child patient):
1. Cross-bite in any region and/or malposition of the mandible when it interferes with facial symmetry or tends to distort the growing facial structures.
2. Complete in-locking of premolars or molars.
   a. Maxillary within mandibular.
   b. Mandibular within maxillary.
3. Class I (Angle) deep overbites in which the mandibular incisors impinge sufficiently on the palatal tissue to endanger its health.
4. Class I (Angle) open-bites.
5. Class I and Class II (Angle) cases which are severe enough to disfigure the individual or to interfere with dental function, or to threaten such interferences later.
6. Cases of supernumerary teeth or congenital absence of teeth.
7. Class III (Angle) cases in which maxillary incisors occlude lingually to the mandibular incisors where diagnosis indicates successful treatment.

Note: These principles obviously should not be considered as the final opinion of the orthodontic profession. The Children's Bureau believes, however, that they may serve as a beginning. Comments and suggestions from orthodontists are invited.

Reports

REPORT OF THE RESEARCH COMMITTEE OF THE AMERICAN ASSOCIATION OF ORTHODONTISTS

In accordance with the action taken by the Board of Directors at the meeting of the Association in Colorado Springs, a prize essay contest has been conducted. Pursuant to the action of the Board of Directors, the conditions of the contest have been changed, increasing the prize to $500 and opening the contest to all individuals in any field related to orthodontics. Thirteen essays were submitted in triplicate form to the Chairman. Each essay was accompanied by identifying sheets which were removed and filed in the office of the Chairman. Copies of the essays were sent to each member of the Committee for judging A list of the papers and their authors follows.

The results of the judges' decisions were:

First Prize: Variations in Facial Relationships. Their Significance in Treatment and Prognosis. Dr. William B. Downs, Graham Building, Aurora, Illinois.

First Honorable Mention: The Application of the Principles of Cephalometric Laminagraphy to Studies of the Frontal Planes of the Head. Dr. Alan C. Brader, Reading, Pennsylvania.

Second Honorable Mention: The Immediate Periodontal Tissue Response to Initially Applied Orthodontic Forces. Dr. Robert E. Moyer, College of Dentistry, Department of Orthodontics, State University of Iowa, Iowa City, Iowa.

The response to the call for essays this year was very encouraging and in marked contrast to previous years. The matter of judging, however, continues to be a source of embarrassment to the Chairman at least, although Dr. Broadbent and Dr. Wylie are both of the opinion that such judging is a part of the duties of the Committee.

The Research Committee strongly recommends that the inclusion of a research section, such as that held during the last Chicago meeting, be a regular part of future meetings of this society. It is not the thought of the Committee, however, that such a section should replace any present part of the program. Realizing that many members of the Association might not be interested in such a section, it would appear wise to schedule it at a time when other activities were being conducted, such as the golf tournament or the table clinics. The sole intent of the Committee is to provide an opportunity for men interested in orthodontic research to meet and exchange ideas. The annual meetings of this society provide the most logical means for this purpose.

The research section would be conducted like those of the International Association for Dental Research. All presentations would be restricted to ten- or fifteen-minute abstracts. All reports would be submitted to the Committee well in advance of the meeting and would be required to meet the standards of correct and scientific reports.

Read at the Forty-fourth Annual Meeting of the American Association of Orthodontists, Columbus, Ohio, April 26-29, 1948.

The Committee notes with regret the death of its most illustrious member, Dr. Milo Hellman. President Jones, at the request of the Chairman, appointed Dr. Wendell L. Wylie, Chairman of the Division of Orthodontics, University of California, to take Dr. Hellman's place.

Respectfully submitted,
WENDELL L. WYLIE,
B. HOLLY BROADBENT,
ALLAN G. BRODIE, Chairman.

PAPERS SUBMITTED IN THE PRIZE ESSAY CONTEST

1. Variations in Facial Relationship: Their Significance in Treatment and Prognosis. William B. Downs, Aurora, Illinois.
2. The Study of the Movements of Certain Teeth During and Following Orthodontic Treatment. Robert Litowitz, Miami Beach, Florida.
3. Analysis of Changes in Molar Relationships by Means of Extraoral Anchorage (Headcap) in Treatment of Malocclusion. Walter N. Epstein, St. Louis, Missouri.
4. Producing Normal Third Molars. Cecil S. Rand, San Francisco, California.
5. Roentgenographic Study of the Position of the Mandible in Normal Occlusion and Malocclusion of the Teeth. Dayton G. Blum and Vernon R. Boman, Northwestern University, Chicago, Illinois.
6. Roentgenographic Study of the Skeletal Pattern of the Head in Children of Mixed Dentition and With Normal Occlusion. William M. Younger, Covington, Tennessee.
7. Change in Molar Relationship in Class II, Division 1 Treatment. Robert B. Hedges, Philadelphia, Pennsylvania.
8. A Serial Roentgenographic Cephalometric Appraisal of Treated Hypothyroids. James S. Gold, Milton B. Engel, and I. P. Bronstein, Chicago, Illinois.
9. A Cephalometric Study of Untreated Class II, Division 1 Malocclusion. Robert Drelich, Jersey City, New Jersey.
10. An Application of the Principles of Cephalometric Laminagraphy to Studies of the Frontal Planes of the Human Head. Allan C. Brader, Reading, Pennsylvania.
11. A Study of the Skeletal Pattern of the Human Face. Warren R. Mayne, Salem Massachusetts.
12. The Influence of Prenatal and Postnatal Malnutrition and Environment on Malocclusion. J. Minez, Newark, New Jersey.
13. The Immediate Periodontal Tissue Response to Initially Applied Orthodontic Forces. Robert E. Moyer, College of Dentistry, Department of Orthodontics, University of Iowa, Iowa City, Iowa.

REPORT OF THE PUBLIC RELATIONS COMMITTEE

To the Board of Directors, American Association of Orthodontists:

In reporting for our Committee, I should like to say first that the Public Relations Committee of the American Dental Association reports that more than usual interest has been shown the past year in orthodontics. They already have some good material but are anxious to increase it; our Committee will be glad to assist them in doing so.

Our Committee of the American Association of Orthodontists has had numerous requests. We have filled them as best we could with the remaining material on hand. Several articles in newspapers and magazines have come to our attention, and fortunately the information was reasonably correct.

We feel, however, that we are in a somewhat static position following the very active days when Mr. Anderson was our Director. We think we have well reaped the rewards of all his good work. Dr. Barber, who was chairman at that time, has copies of records and reports showing the hundreds of contacts made with the many dental societies, public health departments, schools, home nursing, educational departments, dietitians, hospitals, pediatricians, Red Cross nurses, dental assistants, and dental schools.

There may be a distinct need for a larger program of activity now, but it seems questionable if it is advisable to meet such expense at this time. It would probably be better to work through the American Dental Association offices, as has been done for some time.

We have been asked to include in this report that the official licensure system by states is not in conflict with the program of the Council on Dental Education. It presents "states' rights" of control and is so sound in democratic principle and regulatory effect as to merit full recognition for expansion by the Council on Dental Education.

Respectfully submitted,
Henry U. Barber, Jr.,
Harold J. Noyes,
James W. Ford, Chairman.

Read at the Forty-fourth Annual Meeting of the American Association of Orthodontists, Columbus, Ohio, April 26-29, 1948.

Department of Orthodontic Abstracts and Reviews

Edited by

Dr. J. A. Salzmann, New York City

All communications concerning further information about abstracted material and the acceptance of articles or books for consideration in this department should be addressed to Dr. J. A. Salzmann, 654 Madison Avenue, New York City

Condylar Growth and Mandibular Deformities: By Milton B. Engel, D.D.S., M.S., and Allan G. Brodie, D.D.S., M.S., Ph.D., Chicago, Ill., *Surgery* **22**: 976-992, December, 1947.

This report is an analysis of nineteen cases of arrested growth in the mandibular condyles. It is the purpose of this study to emphasize the importance of this area in the development of the jaw as well as in its function.

Mandibular growth results from an integration of activities in a number of areas. Surface apposition, particularly at the alveolar margin, posterior border of the ramus, coronoid tip, and epiphyseal-like growth at the condyle are responsible for major contributions. Concurrently, there is continuous surface remodeling. Normal development of the mandible depends upon synchronous coordination of the growth activities of the various centers. Interference with any one of them may be expected to alter the orderly progression of development. Thus, growth arrests in the condyles reflect themselves as pronounced mandibular deformities.

The condylar growth center maintains its activity longer than most other centers in the head, persisting until at least the twentieth year. This provides the forward and downward vector for mandibular growth and contributes as well to increased width of the jaw.

Disturbance of this area is not uncommon. It may occur as one of the sequelae of a mastoiditis or middle ear infection. Hematogenous infections or those which spread from the dental area may localize in the joint and lead to interference with chondral activity or to ankylosis and/or functional limitations. Similar effects sometimes proceed from traumatic injuries resulting in fractures or in disturbance of the bone-forming cartilage. Two of our cases of arrest were associated with a generalized arthritis which had also involved the temporomandibular joint. More rarely, inactivation of growth results from neoplasms or congenital absence of structure. Endocrine disturbances in animals have been shown to affect condylar growth.

When there was unilateral involvement, the unaffected side usually appeared flat and underdeveloped while the arrested side of the face gave the impression of fullness. The mandible was skewed toward the side of the affected condyle. Palpation of the ramus-body junction generally revealed notching of the lower border. The patient was frequently unable to deviate the jaw toward the normal side, and the mandibular midline shifted toward the abnormal side on protrusion.

With bilateral arrest there was usually a symmetrical type of deformity. This resulted in a *Vogelgesicht* with a markedly retruded mandible and with the chin lying in the hyoid region. Lateral function was not always possible. Antegonial notching was present bilaterally in these cases.

Cases Exhibiting Unilateral Arrests.—The mandibular midline deviated to the affected side and there was a slight asymmetry in mandibular form. The

S. N.-lower border angle was 38 degrees. There was a Class I occlusal relation. In the case of the early arrest there was a marked skewing of the mandible toward the involved side. (In some instances this resulted in complete lingual occlusion of the mandibular teeth on the unaffected side.) The ramus was short and the body height was reduced. The lower border of the mandible just anterior to the junction of the ramus and body was notched and presented an abnormal convexity which was readily palpated. Superposition of the mandibular tracings of the retarded side showed continued adherence to a distorted mode of growth over a period of four years. The S. N.-lower border angle was 45 degrees, indicative of a failure of downward development.

Cases Exhibiting Bilateral Arrests.—Roentgenographic examination of those patients having a bilateral arrest usually showed a symmetrical dysplasia.

Because of the failure in mandibular growth, there is an elimination of the downward and forward movement which is typical of normal development. Apparently the downward component is disturbed more profoundly than the forward component. The evidence for this lies in the findings that the angle which may be constructed between the anterior cranial base S. N. and the lower border of the mandible Go. Gn. invariably lies outside the normal range (32° ± 4.9°). Angles N. S. Gn. and S. N. Gn. also deviate markedly from the normal.

Excellent serial data were available for three of the cases (W. U., F. W., N. S.). The increment curves of the lower border of the mandible (Go. Gn.) for the period of observation were plotted and compared to a control curve. In all instances there was considerable underdevelopment and a more rapid approach to asymptotic form than in the normal, indicating a feeble growth potential which was never restored to healthy vigor. The dysplastic pattern was maintained and was unmodified by orthodontic treatment, which was generally not successful. Certainly growth of the bone was not stimulated and the facial disharmony was accentuated by the opening of the bite which usually resulted from such treatment.

Disturbance of Growth.—The present paper deals with the effect of noxious influences on the active cartilage center at the head of the mandibular condyle. The cases reported illustrate strikingly the typical jaw deformity which results from the ensuing arrest.

When a premature ossification of epiphyseal cartilage occurs, as in chronic arthritis in children, subsequent growth expectancy is poor. It appears that scarring and early ossification of the condyle head may occur not only in polyarthritis but following trauma or infection.

The severity of the deformity is related to the chronology and duration of the arrest. In the case of a unilateral arrest, an early disturbance leads to a marked facial asymmetry. Involvement in the period of growth regression leads to more subtle disturbances which may be reflected primarily by dental occlusal changes such as a shift in the mandibular midline without any profound change in mandibular size or form. Similarly, the earlier bilateral arrests are associated with more pronounced deformities.

Sometimes the arrest is succeeded by a period of growth which is, however, considerably decelerated. It is important to know something about the growth potentialities in these cases, particularly where there is an ankylosis of the jaw. This may be deduced only from serial records over a period of two or three years. If the serial study indicates that growth activity is continuing, even at a low rate, surgical intervention should be ruled out because such intervention will only superimpose another severe growth arrest. If the cartilage has been prematurely ossified or so badly scarred as to preclude further growth, surgery is not contraindicated from the growth standpoint. In older individuals this does not constitute a problem.

The facial pattern in these cases of arrest lies outside the normal range; the deviation is uniform and characteristic and seems to be entirely a result of the mandibular deformity. The failure in forward development accounts for the acute angle S. N. Gn. and the more obtuse N. S. Gn. Failure in ramus height growth is reflected in the larger than normal S. N.-mandibular border angle. This type of facial pattern is also seen in some extreme types of malocclusion (marked Class II, Division 1 malocclusions). It is entirely possible that the etiology of such conditions may be traced to growth disturbances in the condylar center.

One may speculate upon the reason for the notching at the antegonion and the apparent distortion in mandibular form which are pathognomonic of the condylar growth arrest. The most satisfactory explanation would appear to be that growth continues at the angle of the mandible as a result of subperiosteal apposition. Because of the failure at the condyle, forward and downward movement of the body does not occur; there is then a localized thickening of the bone at the angle which accentuates the antegonion. This, coupled with the obtuse angle formed between the cranial base and the lower border of the mandible, is responsible for the characteristic "warping."

Muscle imbalances have been regarded by some as the major factors involved in producing the dysplasia. The validity of such an assumption is difficult to sustain in view of the following findings:

1. Resections either of the condyle or horizontally through the superior portion of the ramus for the correction of mandibular prognathism were performed on an older group of patients (17 to 35 years of age). In none of these cases has there been any significant change in the form of body of the mandible over a subsequent period of several years.
2. Injury to the condylar area in the cases reported here was not always associated with muscle disturbance as evidenced by the normal range of functional movements in some.
3. The authors have seen cases of functional limitation of obscure etiology, that is, almost complete inability to open the mouth, where the condylar area was apparently undisturbed. In these individuals there was no deformity of the jaw.
4. This deformity does not occur in adult temporomandibular ankylosis.

Disturbance of Function.—Condylar growth disturbances are frequently associated with limitations of function, particularly the absence of lateral excursion on one side. This is readily understood if the dynamic anatomy of the external pterygoid is considered. This muscle, which has two heads, lies in a horizontal plane running in a posterolateral direction from before backward. The superior head passes from the inferior part of the lateral surface of the great wing of the sphenoid and from the infratemporal crest; the inferior head originates on the lateral surface of the lateral pterygoid plate. The muscle inserts into the neck of the condyle and into the articular disc of the temporomandibular joint. The right muscle is, therefore, responsible for movement of the jaw to the left while the left muscle controls movement to the right. Both sides act together in executing protrusive and opening movements.

TREATMENT

The problem of treatment is a difficult one. There is no mechanism that will compensate for the lost or retarded growth. Although the deformity may not be progressive, except in some cases of unilateral arrest, it is not self-correcting; the dysplastic pattern of growth continues.

Since orthodontic treatment is capable only of modifying the alveolar process, it is not effective in correcting the basic deformity. The orthodontist

can only strive for a correction of the occlusal relations of the teeth. Even this is difficult because of the growth lag. It has been pointed out that the prognosis for successful orthodontic treatment of patients with facial patterns similar to those included here is poor. The reason may be similar. In most of our cases, the mandibular dental arch was badly crowded and the upper incisors markedly protrusive. In order to secure the retraction of the upper incisors, the proper alignment of the mandibular teeth, and a functional locking of occlusal planes, compromise treatment involving judicious extraction of some units should be considered.

The collaborative efforts of the plastic surgeon and the orthodontist are necessary to attain cosmetic improvement. The insertion of autogenous cartilage transplants on the flattened side of the face in the asymmetries and in the mental area where there has been a bilateral arrest are particularly effective. Attempts to bring the mandible forward by a combination of surgical and orthodontic means have not met with consistent or noteworthy success to date.

CONCLUSIONS

1. The condylar area is characterized by intense chondral activity and subsequent ossification similar to that occurring in the epiphysis of a long bone. This activity is greatest during the fetal period and the early years, tapering to a standstill between the ages of 16 and 20 years.

2. Injury to the condylar center results in a growth arrest and consequent characteristic distortion of mandibular form.

3. Because of its condylar insertions, the functions of the external pterygoid muscle are frequently impaired in such cases.

4. The mandible that has become dysplastic through an early arrest will, if recovery occurs, follow the dysplastic pattern without any compensating acceleration, and thus the end result is an underdeveloped mandible.

5. The growth disturbance resulting from the arrest is not corrected either by orthodontic treatment or by surgical procedures. However, these measures may yield a degree of cosmetic improvement.

6. Surgical interference in the temporomandibular joint area should be undertaken most cautiously and only after serial observation of the patient has shown that growth has ceased. Otherwise, there is danger that an additional arrest will be superimposed on an already retarded growth center.

News and Notes

Prize Essay Contest, American Association of Orthodontists

Eligibility.—Any member of the American Association of Orthodontists; any person affiliated with a recognized institution in the field of dentistry as a teacher, researcher, undergraduate or graduate student shall be eligible to enter the competition.

Character of Essay.—Each essay submitted must represent an original investigation and contain some new significant material of value to the art or science of orthodontics.

Prize.—A cash prize of $500 is offered for the essay judged to be the winner. The committee, however, reserves the right to omit the award if in its judgment none of the entries is considered to be worthy. Honorable mention will be awarded to those authors taking second and third places. The first three papers will become the property of the American Association of Orthodontists and will be published. All other essays will be returned.

Specifications.—All essays must be typewritten on 8½ by 11 inch white paper, double spaced with 1 inch margins, and composed in good English. Three copies of each paper, complete with illustrations, bibliography, tables, charts, etc., must be submitted. The name and address of the author must not appear in the essay. For purposes of identification, the author's name together with a brief biographical sketch which sets forth his or her dental and/or orthodontic training, present activity, and status (practitioner, teacher, student, research worker, etc.) should be typed on a separate sheet of paper and enclosed in a sealed envelope. The envelope should carry the title of the essay.

Presentation.—The author of the winning essay will be invited to present it at the meeting of the American Association of Orthodontists to be held in New York City, New York, May 2-6, 1949.

Final Submission Date.—No essay will be considered for this competition unless received in triplicate by the Chairman of the Research Committee on or before March 15, 1949.

Allan G. Brodie, Chairman Research Committee,
American Association of Orthodontists,
30 North Michigan Avenue, Chicago 2, Ill.

Northeastern Society of Orthodontists

The Fall Meeting of the Northeastern Society of Orthodontists will be held at the Hotel Commodore, New York, N. Y., on Nov. 22 and 23, 1948.

Central Section of the American Association of Orthodontists

The regular annual meeting of the Central Section of the American Association of Orthodontists will be held Oct. 25 and 26, 1948, at the Corn Husker Hotel, Lincoln, Nebraska.

Great Lakes Society of Orthodontists

The Nineteenth Annual Meeting of the Great Lakes Society of Orthodontists will be held Oct. 18 and 19, 1948, at Hotel Statler in Cleveland, Ohio.

Dr. F. Copeland Shelden, Dr. Ashley E. Howes, Dr. B. Holly Broadbent, and Dr. Samuel Chase will be the essayists.

Table clinics will be presented. Time for fellowship is essential to all outstanding meetings. Please make your hotel reservations in ample time. We do not want you to be inconvenienced.

Southern Society of Orthodontists

The Southern Society of Orthodontists will hold its annual meeting Oct. 11, 12, and 13, 1948, at Hotel Peabody, Memphis, Tennessee.

Rocky Mountain Society of Orthodontists

The Rocky Mountain Society of Orthodontists will hold a two-day meeting Oct. 13 and 14, 1948, at the Cosmopolitan Hotel, Denver, Colorado. Dr. Spencer R. Atkinson of Pasadena, California, will be on the program both days.

Northern Section, Pacific Coast Society of Orthodontists

The Northern Section of the Pacific Coast Society of Orthodontists held a meeting on May 17, 1948, in Seattle, Washington, at the Washington Athletic Club.

The meeting was called to order at 9:00 A.M. by temporary chairman A. E. Stoller, who presided in the absence of Chairman Emery Fraser, who was ill and unable to attend.

The scientific session was called to order at 10:00 A.M. A. E. Stoller introduced the guest essayist, Dr. John R. Thompson. Director of the Orthodontic Department of Northwestern University Dental School, Chicago, Illinois, Dr. Thompson reviewed the research on the rest position of the mandible and followed this with a treatise on the application of rest position of the mandible to functional analysis and treatment planning. Models of cases treated accordingly were shown to demonstrate the practicability of this discussion.

Dr. Thompson concluded the afternoon session with a discussion on cephalometric analysis and how it may be used clinically.

The Northern Section gave Dr. Thompson a unanimous vote of thanks for his time and effort in presenting such an interesting, practical, and scientific meeting.

Central Section, Pacific Coast Society of Orthodontists

The Central Section of the Pacific Coast Society of Orthodontists held a meeting on Tuesday evening, June 8, 1948, at the Alexander Hamilton Hotel in San Francisco.

Dr. Russell presented Clu Carey as the essayist for the evening, his topic being, "Determination of Linear Arch Dimension and Its Relation to the Quality of Tooth Structure." This was an excellent paper, illustrated with slides, and presented some original material most useful in the treatment planning. Those who missed this meeting would do well to familiarize themselves with Clu's work on this subject.

Southern Section, Pacific Coast Society of Orthodontists

The Southern Section of the Pacific Coast Society of Orthodontists held its regular quarterly meeting June 11, 1948, at the Rodger Young Auditorium, Los Angeles, California.

The Chairman, David England, called the meeting to order at 2:00 P.M. and presented Herbert Muehnic, General Program Chairman. The program chairman for the day, Mahlon Adams, was presented by Herbert Muehnic.

Mahlon Adams introduced the speaker, Charles Tweed, and the clinicians for the day, who presented the following program:

An afternoon session composed of "Orthodontics Past and Present" by Charles Tweed, Tucson, Arizona.

Thirteen progressive table clinics, demonstrating space-closing procedures in extraction cases by the following clinicians: Glenn W. Foor, W. J. Babnick, Homer Garcia, Al F. Heimlich, Howard Lang, Matthew Lasher, Robert B. Payne, John Rathbone, Betty Selmer, Glendon H. Terwilliger, William Tweed, Fay Van, and William E. Grenfell.

This was followed by a social hour, dinner, and an hour period for general discussion of Charles Tweed's paper, which was followed by the business meeting.

California State Dental Association

In San Francisco's Palace Hotel last April, the California State Dental Association held its seventy-eighth annual meeting. Appearing on the program were:

Wendell L. Wylie—his subject, "Dental Specialties—Autonomous Control or by Legislation."

J. Camp Dean—his subject, "A Study of Growth and Development Due to Orthodontic Stimulation." By means of lantern slides and plaster models, he demonstrated how sufficient space could be gained for proper tooth alignment and normal occlusion done exclusively by expansion.

Graduate Work in Orthodontics, University of Illinois

Ten dentists have been selected by the University of Illinois, College of Dentistry, for graduate work in the field of orthodontics (the correction of teeth irregularities) in an eighteen-month course starting this fall.

Dean Allan G. Brodie has announced that the ten dentists were selected from a large list of applicants. The course, formerly fifteen months in length, has been extended to eighteen months to provide more clinical training.

The objective of the course will be to produce scientific practitioners in the specialty. Dentists who successfully complete the study will be awarded a master of science degree. The University of Illinois has offered graduate work in the field of orthodontics since 1929.

Dentists who have been selected for the course starting this fall are: Dr. N. L. Speck, El Paso, Texas; Dr. A. L. Posen, Toronto, Ontario; Dr. Henry Peterson, Elmira, New York; Dr. John H. McNutt, Brooklyn, New York; Dr. Levern Merrifield, Chickasha, Oklahoma; Dr. Milton Lande, Philadelphia, Pennsylvania; Dr. Philip L. Klein, Syracuse, New York; Captain Charles E. Craig, Vancouver, British Columbia; Dr. Arthur Chun-Hoon, Honolulu, T. H.; and Dr. Dan H. Watkins, Moline, Illinois.

Notes of Interest

Sidney Brandt, D.D.S., announces the opening of additional offices at 321 Millburn Avenue, Millburn, New Jersey, for the exclusive practice of orthodontics.

Dr. Leonard T. Walsh wishes to announce the association of Dr. Eli H. Mullinax, 442 Thatcher Building, Pueblo, Colorado, practice limited to orthodontics.

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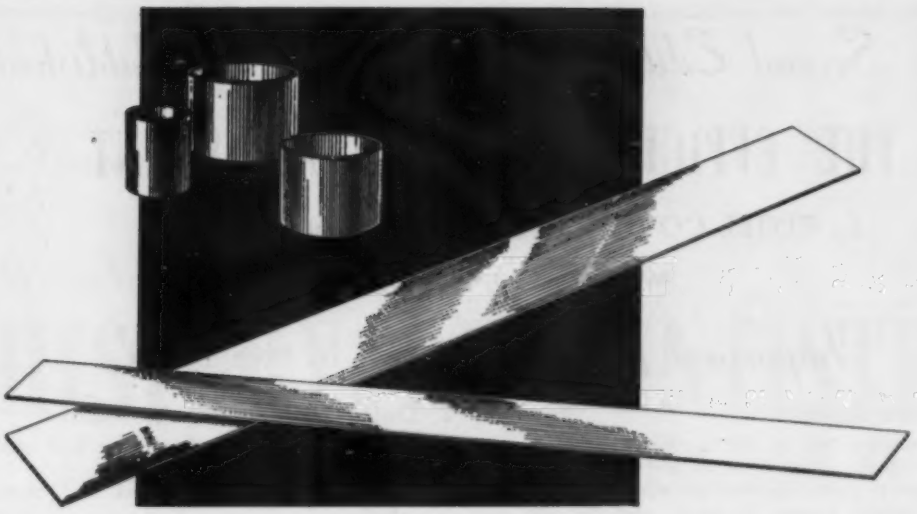

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